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Comparison of the Rail Roads of Belgium with those of the United States.
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The rapid increase of Internal Improvements in the United States has excited for several years public attention in Europe, and the friends of those improvements desired very much a detailed report on the extent and progress of those works, and particularly of *Rail Roads*. There is no such report published in the United States, and even those published in England, France, and Germany are very imperfect.

In 1824 I had charge of the first Rail Road on the continent of Europe, to connect the rivers Moldau and Danube in Austria, by a line which is one hundred and thirty miles long, and which has been in operation since 1832. I constructed in 1836 and 1837 the first Rail Road in Russia, from St. Petersburg to Zarskoe-Selo and Pawlowsk, a line of only 17 miles in length, but forming the commencement of a Rail Road of four hundred and twenty miles from St. Petersburg to Moscow. This Rail Road being likewise in full operation, I left Europe last fall and arrived in the Great Western on the 15th of November, 1838, at New York. After a short stay of a few days I went to Albany, and inspected all the Rail Roads between that place and Lake Erie; I then proceeded to the Eastern States and visited all the Rail Roads in Massachusetts, and went via New York, Philadelphia, Baltimore, and Washington, through Virginia, North and South Carolina, Georgia, and Alabama, to New Orleans, always visiting the Rail Road lines in the different States. I went then up the Mississippi and Ohio, and am now about inspecting the Internal Improvements of the Western States, and some of those in Pennsylvania, which I have not yet seen.

I have already passed over more than two thousand miles of Rail Roads, and have every where been received with the greatest kindness; the Presidents, Directors and Engineers of the different Rail Road lines gave me

not only all their printed reports, but laid before me, with the greatest liberality, their books and accounts, in order to afford me every kind of information. I fulfil only my duty when I publicly acknowledge, that such a liberality is only to be found amongst a free and enlightened people, where all public works are based on the principle of publicity, and where secrets do not exist. I wish, therefore, to make those gentlemen, to whom I am so much indebted, another communication, which will show at the same time what has been done during the last years in Europe. Having within a few days received the last Reports on the Belgian Rail Roads, I publish in the following abstract the history and progress of those communications in Belgium, together with a comparison of them with the American Rail Roads.

According to the facts collected during my travels since my arrival in New York, there are now *over three thousand miles of Rail Roads completed and in operation in the United States;* four hundred and twenty-five locomotives, of which the greatest number were made in this country, run on the several Rail Roads, and I believe, that up to the end of 1839, the length of Rail Roads in the United States may amount to forty-one hundred miles. The capital expended on the Rail Roads now in operation is about sixty millions of dollars, or at an average cost of twenty thousand dollars per mile, for which sum the Rail Roads, with the buildings, have been constructed, and the necessary locomotives and cars bought.

Several Rail Roads have been undertaken with insufficient means, and the shareholders found themselves under the necessity of employing the income of the first years in improving the Rail Road, in building engine-houses, &c. and purchasing locomotives and cars. In consequence of this the shareholders got during that time no dividends, but the Rail Road still yielded a good income. Other Rail Roads, when finished, paid from five to ten per cent. income to the stockholders; others have not yet paid any dividends for want of a sufficient number of passengers and freight. The *average result* of the Rail Roads now in operation in the United States is, *that they give a yearly interest of five and a half per cent. on the capital invested.* This result must be regarded as very satisfactory, because the greatest part of the lines have only been a few years in operation.

On all lines there is a yearly increase of at least from fifteen to twenty per cent. in the gross income, so that even those lines which do not pay now will give in a few years a handsome dividend. According to these statements, based on the communications collected in this country, I have no doubt, that the large capital invested in Rail Roads, in the United States, will not only produce an incalculable benefit to the country, but likewise pay the shareholders a dividend, which under good management, by the constant progress in population and trade, must likewise from year to year increase.

Good book-keeping and clear accounts are matters of importance in every business; Rail Roads are new constructions, and experience, particularly in working them, is still very much wanted. When the Superintendent of a Rail Road in operation keeps clear and distinct accounts, he will in a few years learn by experience what can be improved, and which items of expenses can be reduced. The following statement contains a manner of making the Rail Road accounts, which, in my opinion, must prove very useful for every Rail Road Company.

I. History, Length and Cost of Construction of the Belgian Rail Roads.

The Rail Roads, which up to the present time have been constructed in

England and on the continent of Europe, had no other object than to connect two important places of the country, and in constructing them, therefore, local interest more or less prevailed. That Rail Roads are to be considered *as great thoroughfares*, that they can form in a country the principal lines of internal communication—that, therefore, the means for their establishment should be such, as only can be raised by a whole nation, nobody in Europe would have maintained previous to 1834, and it is even now denied by many individuals of high standing and influence. Belgium, united with Holland since 1815, had distinguished itself in Europe, by its fine roads, and magnificent canals; the latter, being constructed, for the greatest part, in a level country, and without locks were used not only for the transportation of goods, but also for passengers, especially the lower classes, which there, more than in any other country, made use of the canal boats for their travels. It is evident, that no individuals would ever have attempted to construct Rail Roads parallel, and in opposition, to such canals and turnpike roads.

In the year 1830, Belgium declared itself independent of Holland, and elected by the representatives of the nation its own sovereign. King Leopold I. soon discovered, that the country, for its perfect tranquillity, wanted "labour;" a series of wise legislation encouraged the nation to useful and profitable enterprizes, and every person with talent and inclination found employment and earnings in a country, which isolated from all its neighbours, was confined to its own resources. But to gain over public opinion, a great national work was to be accomplished by the new government, which might fill posterity with admiration. The time was past for Egyptian pyramids, for Roman triumphal arches, and French monuments of war. A more useful monument, one of peace and intelligence, was to remind the nation of that eventful period. The King ordered the whole country to be surveyed by able Engineers, the necessary plans and estimates formed, and on the first of May 1834, a law was proclaimed, according to which *a system of Rail Roads was to be introduced through the whole kingdom, and executed at the expense of the State;* on two points (at Antwerp and Ostend), the Rail Roads were to lead to the seaports, on two points to connect with France, and on one point with Prussia (Germany.)

The news of the gigantic work, undertaken by a State, even not yet acknowledged as such by the northern powers, and with only four millions of inhabitants, excited the greatest surprise in Europe, and few only could conceive the great results, which this grand project must necessarily produce *on the independence of the nation and its internal welfare*, its commerce and industry; the former being the principal aim and the promotion of commerce and industry a subordinate one, although the great mass of the people were unable to comprehend the grand idea of the plan.

King Leopold found in his former minister of public works, Mr. De Theux, and in his successor, Mr. Nothomb, vigorous supporters. The Engineers were vieing in the swift prosecution of the work, and, in the course of four years, more has been done than was expected. The enlightened minister Nothomb published annual reports to the Legislative Assembly, besides other special reports of the progress of the works, in which the public in Europe find a rich source of experience, not to be met with in any other report or work on the subject. Europe has to render thanks to the King, who the first realized such a grand idea, and to his enlightened minister, who judiciously conducted the work, and so liberally communicated its results.

The limited space of this report does not allow a detailed extract from the above mentioned reports of the minister Nothomb and the Engineers; I shall therefore only give a brief account containing the results in numbers, and afterwards compare these results with those of Rail Roads in the United States. The following table contains the sections of the Rail Roads which were opened up to the end of 1838, and their lengths in mètres and English miles.

Section of Rail Road.		Time of opening.	Length.	
From	To		In French mètres.	In English miles.
Brussels,	Malines,	5 May 1835,	20,300,	12.6
Malines,	Antwerp,	3 May 1836,	23,500,	14.6
Malines,	Termonde,	2 January 1837,	26,700,	16.5
Malines,	Louvain,	10 September 1837,	23,750,	14.7
Louvain,	Tirlemont,	22 September 1837,	17,750,	11.0
Termonde,	Gent,	28 September 1837,	30,500,	18.9
Tirlemont,	Waremme,	2 April 1838,	27,200,	16.8
Waremme,	Ans,	2 April 1838,	18,900,	11.7
Gent,	Bruges,	12 August 1838,	44,500,	27.6
Bruges,	Ostend,	28 August 1838,	23,500,	14.6
		Total,	256,600	159.0

According to the report, made by the minister to the house of Representatives, on the 26th November 1838, the above ten sections including buildings, locomotives and cars cost thirty-four millions of francs; this gives per mile of Road forty-one thousand three hundred dollars. The Rail Road from Brussels to Antwerp, 27.2 miles, has a double track, the remainder are constructed with only a single track, the rails weighing forty-five pounds per yard. But there are several buildings yet to be erected, and different works on the line to be executed, and besides a number of freight cars to be provided for, &c.; with all this the cost per mile will amount to forty-five thousand dollars.

II. Tariff for Passengers, Speed.

There are on the Belgian Rail Roads four classes of passenger cars, differing only in elegance and comfort, but going in the same train, and therefore with equal velocity. The prices are:

In the Berlines, . .	2¾ cents per mile,	For each Passenger with 44 lbs. of baggage.
" Diligences, . .	2 " " "	
" Chars à Bancs,	1½ " " "	
" Wagons, . .	0.8 " " "	

The trains perform at an average of seventeen English miles per hour, all stoppages included, or from twenty to twenty-five miles while running.

III. Traffic and Revenue on the Belgian Rail Roads.

The Rail Roads in Belgium are frequented by more passengers than any other Rail Roads; the transportation of freight was only begun between Brussels and Antwerp, in 1838. The following table shows the travel since the opening of the first section, until the 31st of October 1838.

Period.	Total number of passengers.	Average distance performed by each passenger	Number of passengers reduced for one mile.	Gross Income.		
				From all passengers		per pas. per mile
		Miles.		Francs.	Dollars.	Am. cts.
From 5th May 1835 to 2d of May 1836	563,201	11.6	6,536,754	359,394	67,429	1.03
From 3d of May to 31st of of Dec. 1836	729,545	20.2	14,718,709	734,736	137,849	0.90
In the year 1837	1,384,577	17.2	23,838,436	1,416,983	265,850	1.11
From 1st of Jan. to 31st of Oct. 1838.	1,921,619	22.8	43,887,864	2,589,384	485,813	1.11
In 3 years 6 months	4,598,942	19.35	88,981,763	5,100,497	956,941	1.07

to which must be added forty-four thousand one hundred and forty-eight francs, or eight thousand two hundred and eighty-one dollars, as the gross income from freight in the year 1838.

In the year 1837, there were among the number of passengers, thirty thousand eight hundred and fifty-seven soldiers, for whom, in consequence of an arrangement with the ministry of the War Department, only half price was paid.

In 1838 the total number of passengers amounted, according to the "Moniteur Belge," to two million two hundred and thirty-eight thousand three hundred and three, comprising fifty-six thousand six hundred and eighteen soldiers, and the gross income was three million one hundred thousand eight hundred and thirty-three francs forty centimes (five hundred and eighty-one thousand seven hundred and seventy dollars). As the average distance performed by each passenger in the first ten months of 1838 is not mentioned in the Report of the Minister, I have supposed the income per passenger per mile to be the same as in 1837, out of which results an average distance of 22.8 miles. In order to show how the traveling public made use of the different classes of cars, the following contains the number of passengers in each class of cars, and the revenue resulting therefrom for the year ending 31st December 1838. During this period there were

17,503	passengers,	I. class,	who paid	69,322 francs 65 centimes.
215,893	"	II. class,	"	702,502 francs 70 centimes.
604,935	"	III. class,	"	1,033,953 francs 05 centimes.
1,343,354	"	IV. class,	"	1,087,790 francs 45 centimes.
56,618	soldiers,		"	45,248 francs 88 centimes.
	For overweight of bag. and freight,			162,015 francs 67 centimes.
2,238,303	passengers and total income,			3,100,833 francs 40 centimes.

These numbers explain sufficiently that the Rail Roads in Belgium are used principally by the lower classes of the people.

IV. Cost of working the Belgian Rail Roads.

The accounts kept under this head contain an exact subdivision of the different expenses occurring in working the Rail Roads; the first general subdivision contains *the maintenance of way and police;* the second *the cost of transportation*, viz. fuel, engineers and firemen, repairs of locomo-

tives and cars, grease for the same, also the expenses for conductors, carriers and baggage men; the third embraces *the general expenses*, viz. clerks and ticket sellers, comptrollers, printing, advertising, office expenses, &c. The annexed table contains the expenses under the different heads:

Period.	Maintenance of way and police.	Transportation account.	General expenses.	Total.	
	francs.	francs.	francs.	francs.	dollars.
From 5th May to 31st Dec. 1835	50,584 01	105,967 88	12,220 84	168,772 73	31,665
Year 1836,	132,637 41	261,778 30	36,719 96	431,135 67	80,888
Year 1837,	345,824 53	664,940 46	144,706 92	1,155,471 91	216,786
From 1st Jan. to 31st Oct. 1838	377,822 58	1,059,180 71	182,186 48	1,619,189 77	303,788
In 3 years and 6 months,	906,868 53 or 27 pr. ct.	2,091,867 35 or 62 pr. ct.	375,834 20 or 11 pr. ct.	3,374,570 08 or 100 pr. ct.	633,127

As this table contains the expenses of working the Rail Roads three and a half years, these numbers may certainly be regarded as the result of a great experience.

V. Cost of Repairs of Locomotives and Cars.

In the last table the sum of one million fifty-nine thousand one hundred and eighty francs, seventy-one centimes, appears under the head of transportation account for ten months in 1838. This sum contains the expenses for foremen in the shops, ... 32,177f. 54c.
For labourers expenses, ... 187,463f. 61c.
At the principal shops in Malines, ... 54,868f. 72c.
For materials for repairs, ... 87,965f. 66c.

Total, 362,475f. 53c.

or sixty-eight thousand and six dollars, which is 34 per cent. of the expenses of transportation. I believe that the expenses for repairs of engines and cars might be diminished by the introduction of locomotives with moveable trucks in front, and of eight wheeled passenger and freight cars.

VI. Expenses per Passenger per Mile.

The accurate number of miles performed by passengers not being contained in the last report, the expenses per passenger per mile can only be found up to the end of 1837. According to the last statement, the expenses from the 5th of May 1835, to the 31st of December 1837, were:
For maintenance of way, ... 329,045f. 95c.
Transportation account, ... 1,032,686f. 64c.
General expenses, ... 193,647f. 72c.

1,755,380f. 31c.

During the same period the number of passengers reduced to 1 mile was equal to forty-five million ninety-three thousand eight hundred and ninety-nine, which divided in the above ratio gives as the expenses per passenger per mile,

For maintenance of way, . .	1.17 centimes, or	0.22 cents.
Transportation account, . . .	2.29 centimes, or	0.43 cents.
General expenses, ...	0.43 centimes, or	0.08 cents.
Total,	3.89	0.73 cents.

These expenses are very low, and are exceeded on every other Rail Road.

VII. Expenses per Mile of Travel.

The number of miles performed by all the locomotives with their trains was:

From 5th May 1835, to 2d May 1836, . . .	14,810 lieues.
From 3d May 1836, to 31st December 1836, . .	24,825 lieues.
From 1st January 1837, to 31st December 1837, .	61,592 lieues.
Total,	101,227 lieues.

at five thousand mètres, or three hundred and fourteen thousand five hundred and six English miles; the expenses during the same period of two years and 8 months were

For maintenance of way,	529,045f. 95c.	
. . . . .		therefore per mile of travel,
. . . . .		1f. 68c. or 31½ cents.
For transportation account,	1,032,686f. 64c.	3f. 28c. or 61½ cents.
General expenses,	193,647f. 72c.	0f. 62c. or 12 cents.
Total,	1,755,380f. 31c.	5f. 58c. or 105 cents.

The expenses for every mile which a locomotive with its train runs, amount therefore to five francs fifty-eight centimes, or one dollar and five cents, being very nearly the same as on the American Rail Roads.

VIII. Number of Passengers per Trip.

In the table No. III., we have shown that the number of passengers from the 5th of May 1835, to the 31st of December 1837, reduced for the length of a single mile of road, amount to forty-five million ninety-three thousand eight hundred and ninety-nine; during the same period the trains performed three hundred and fourteen thousand five hundred and six miles; this gives one hundred and forty-three as the average number of passengers in a train. This number compared with 5f. 58c. as the expenses per mile of travel, gives again 3.89c. or 0.73 cents as the expense per passenger per mile.

IX. Comparison between the Gross Income and the Net Revenue.

The following table contains the annual gross income, current expenses and the surplus of income over the expenses, as is related in the Report of the Minister, of the 26th of November 1838, to which is annexed the annual surplus for every one hundred francs of the gross income.

Period.	Total gross income.	Current Expenses.	Surplus of the revenue over the expenses.	From 100f. of the gross income remained after defraying all expenses.
	francs. cent.	francs. cent.	francs. cent.	
5th May 1835, to 31st Dec. 1835,	268,997 50	168,772 73	100,224 77	37f. 26 centimes.
Year 1836,	825,132 85	431,135 67	393,997 18	47f. 75 centimes.
Year 1837,	1,416,982 94	1,155,471 91	261,511 03	18f. 46 centimes.
1st Jan. 1838, to 31st Dec. 1838,	2,633,532 21	1,619,189 77	1,014,342 44	38f. 52 centimes.
Total,	5,144,645 50	3,374,570 08	1,770,075 42	34f. 41 centimes.

As an average, therefore, of three and a half years, of every one hundred francs revenue, only thirty-four francs forty-one centimes remained, but as all the locomotives and cars are still new, and no amount for general depreciation appears under the expenses, it is to be supposed, that in future only thirty francs will remain from one hundred. This surplus serves as interest and a sinking fund for the capital.

X. Gross Income per Mile of Rail Road.

The public in Europe is, almost throughout, of opinion, that only short lines, and these especially between two populous cities, will pay a good interest, and that the branch roads extending to remote, less populated, parts of a country will never yield any profit. What results the Belgian roads give in that respect, the annexed table will show:

Period.	No. of sections opened.	Average length of road in operation	Gross income during the whole period.	Annual income per single mile of road.	
			francs. cent.	francs. cent.	dollars.
5th May to 31st Dec. 1835,	1	12.6	268,997 50	32,333 73	6,066
Year 1836,	2	22.3	852,132 85	38,212 23	7,169
Year 1837,	6	56.1	1,416,982 94	25,258 16	4,739
1st Jan. to 31st Oct. 1838,	10	118.7	2,633,532 21	26,638 34	4,998
Total,		53.1	5,144,465 50	27,735 98	5,204

In the second column for the year 1835, appears only the section between Brussels and Malines of 12.6 miles opened at that time. In the year 1836, these 12.6 miles were in operation for three hundred and sixty-five days, and the second section from Malines to Antwerp, of 14.6 miles, for two-hundred and forty-three days only. In multiplying the length of each section by the respective number of days, and dividing the sum by three hundred and sixty-five, we obtain 22.3 miles as the average length in operation during the whole year 1836. In the same manner the average length was obtained for the years 1837 and 1838. The last column shows, that the annual receipt per single mile of road amounted in the first year, when the novelty attracted many passengers, and only 12.6 miles were opened, to thirty-two thousand three hundred and thirty-three francs, seventy-five centimes, and that in the third and fourth year, when curiosity attracted but few, and the greatest number travelled for business only, and while a much greater length of road was in operation, these receipts amounted still to twenty-six thousand five hundred francs per mile yearly. This amount will undoubtedly be increased in the following years, as in 1838 four new sections came into operation, on which the traffic will develope itself only by and by; besides there will be the transportation of goods, which for the year 1839, is estimated to give a revenue of eight hundred and fifty thousand francs for one hundred and fifty-nine miles, or five thousand three hundred and forty-six francs per mile; the gross income on the Belgian Rail Roads, will therefore also in future, like the first year, amount to about thirty-two thousand francs per mile of road annually. That by the increase of population and commerce, also, this income of thirty-two thousand francs will be increased, is evident; the Rail Roads in Belgium serve therefore as a proof, that long lines of Rail Roads may (some extraordinary circumstance excepted,) be executed with equal success as short ones.

It would be quite erroneous in calculating the revenue of a system of Rail Roads, Canals, or Turnpike roads, to regard the income on the principal line separately, and so the revenue of each of the branch lines, in order to judge of the value of each of them. By the opening of a branch line the income of the main line must become greater; because the passengers and freight from the branch lines will pass over the same and increase the revenue. The accurate way of calculating a whole system of Rail Roads, Canals, or Turnpike roads, must therefore be to compare the *total income of the main line as well as of the branch lines*, with the *total length of all the lines*, in order to find the *average income per mile;* and in deducting therefrom the expenses, the balance will show, when compared with the cost of construction per mile, what interest ensues for the capital invested.

XI. Budget for the Operations of the Belgian Rail Roads in the Year 1839.

We have seen that the annual gross income amounts to thirty-two thousand francs per mile, therefore for the one hundred and fifty-nine miles, which are in operation to five million eighty-eight thousand francs. After defraying all the expenses from one hundred francs gross receipts there remain thirty-four francs forty-one centimes, the nett income will, therefore, be one million seven hundred and fifty thousand seven hundred and eighty francs, instead of which the minister in his Budget anticipates the amount at one million seven hundred thousand, to which he is led by a different calculation. This surplus is exactly five per cent. of the capital expended of thirty-four million francs. These five per cent. suffice for interest and sinking fund, and therefore the Belgian Rail Roads fulfil their object, to maintain themselves without being a charge to the State Treasury.

XII. Increase of Income from the Mail and Turnpikes.

As an objection against Rail Roads it was further maintained, that their introduction in a country will lessen considerably the receipts of tolls on turnpike roads and of the mail, because there will be less travel on turnpike roads, and letters will be carried by persons who travel on Rail Roads; the same opinion appears to have existed in Belgium. On the 27th of January 1838, the Minister, Mr. Nothomb, declared in the Senate, that the revenue of the mail in 1837 exceeded that of 1836 by two hundred and sixty-two thousand three hundred and seventy-three francs, and the tolls on turnpike roads by one hundred and ten thousand francs, for the reason that although the tolls on those roads which go in a parallel direction with Rail Roads are lessened, yet they are increased in a greater proportion on those turnpike roads which lead to the Rail Roads, as they are passed over by all who come to travel on the latter. The revenue from the mail increased in consequence of the greater intercourse occasioned by the introduction of Rail Roads.

XIII. Comparison of the Belgian Rail Roads with those in the United States.

According to Table under No. III, the number of passengers during three and a half years, reduced for the length of one mile, amounted on the Belgian Rail Roads to eighty-eight million nine hundred and eighty-one thousand seven hundred and sixty-three, or at an average per year of twenty-five million four hundred and twenty-three thousand three hundred and sixty-one. As the average length of road in operation during the whole time was 53.1 miles, we have four hundred and seventy-eight thousand

seven hundred and eighty-three through passengers, annually. The *Belgian Rail Roads are therefore traveled over on their whole length by nearly five hundred thousand passengers per year.* We have now the following comparison:

(*a.*) *Cost of construction.*—A mile of Rail Road with a single track, and the necessary buildings and outfit, costs in America twenty-thousand dollars; in Belgium forty-one thousand three hundred dollars, or more than twice the amount.

(*b.*) *Tariff.*—On the American Rail Roads, a passenger pays at an average five cents per mile; on the Belgian Rail Roads, only one cent or five times less; for freight the charge is, in America, at an average seven and a half cents per ton per mile.

(*c.*) *Speed.*—On the American Rail Roads, passengers are conveyed with a speed of from twelve to fifteen miles per hour, stoppages included, on the Belgian Roads at the rate of seventeen miles, or stoppages not included; at the rate of from twenty to twenty-five miles.

(*d.*) *Traffic.*—There are at an average, thirty-five thousand through passengers, and fifteen thousand tons of goods carried annually over the American Roads; on the Belgian there have been carried per year four hundred and seventy-eight thousand seven hundred and eighty-three through passengers, and the transportation of goods only commenced a short time since.

(*e.*) *Gross income.*—The same amounts on the American Rail Roads, at an average per mile and per year,

From 35,000 passengers at 5 cents, . . .	1750 Dollars.
From 15,000 tons of goods at $7\frac{1}{2}$ cents, . . .	1125 Dollars.
From mail and contingencies, ...	200 Dollars.
Total,	3075 Dollars.

On the Belgian Rail Roads the gross income per mile from four hundred and seventy-eight thousand seven hundred and eighty-three passengers, and the transportation of freight, amounts to thirty-two thousand francs or six thousand and three dollars seventy-five cents per year.

(*f.*) *Expenses per mile of travel*—These amount on the American Rail Roads to one dollar, on the Belgian Roads to one dollar five cents, or they are the same in both countries.

(*g.*) *Number of passengers per trip.*—In Belgium there were in each train, at an average of three and a half years, one hundred and forty-three through passengers; on the American roads, a passenger train contains only forty through passengers, at an average.

(*h.*) *Number of trips per year.*—In dividing thirty-five thousand by forty we obtain eight hundred and seventy-five, as the average number of passenger trips per year on the American Rail Roads; and in dividing four hundred and seventy-eight thousand seven hundred and eighty-three by one hundred and forty-three we get three thousand three hundred and forty-eight, which represents the average number of passenger trains passing annually over the Belgian roads. As at the same time the speed on the latter is greater than on the American Rail Roads, it was necessary to employ rails of forty-five pounds per yard, while their weight is generally less on the American Rail Roads.

(*i.*) *Expenses per passenger per mile.*—These are in Belgium only 0.73 cents, and in America two and a half cents, or three and a half times more. The reason of this is, that the American trains contain three and a half times less passengers, while the expenses per train per mile are equal in both

countries. It is very nearly the same for a Locomotive to carry forty or one hundred and forty-three passengers in a train.

(*k.*) *Annual current expenses.*—In America the annual current expenses for working a Rail Road, are per mile,

For transportation of 35,000 passengers, at 2½ cents,	875 Dollars.
For transportation of 15,000 tons of goods at 6½ cents,	975 Dollars.
For transportation of the mail and other expenses,	100 Dollars.
Total,	1950 Dollars.

Or sixty-three dollars forty-one cents of every one hundred dollars gross income. On the Belgian Rail Roads, of every one hundred dollars gross revenue, the expenses are sixty-five dollars fifty-nine cents, or per year per mile three thousand nine hundred and thirty-seven dollars eighty-six cents.

(*l.*) *Interest on the capital invested.*—In America the annual average gross income, per mile of Road, amounts to 3075 dollars, the annual current expenses to one thousand nine hundred and fifty, leaving one thousand one hundred and twenty-five dollars; which compared with the cost of a mile of Road (twenty thousand dollars,) give five and a half per cent. interest. On the Rail Roads in Belgium, the annual gross income per mile, is six thousand and three dollars seventy-five cents, the expenses three thousand nine hundred and thirty-seven dollars eighty-six cents, leaving two thousand and sixty-five dollars eighty-nine cents as interest on the cost of forty-one thousand three hundred dollars per mile, or exactly five per cent.

XIV. General Remarks.

The comparison of the results of the Belgian Rail Roads with those of the Rail Roads in the United States of America, speaks evidently in favour of the former. The extremely low charges for passage on the Belgian Rail Roads has increased the number of passengers in an unparalleled degree, and produced an intercourse not attained in any other country of the world. While the higher prices in the better classes of cars yield a considerable profit, the price in the last class, or for the great mass of the people, is so low that it about covers the expenses only. The Belgian Rail Roads are, therefore, throughout, a great popular, democratic establishment, which must have met the approbation of the people, and of every intelligent man; the Belgian Rail Roads afford to the government the greatest facility in the transportation of troops, the importance of which was evinced principally during late years; the Belgian Rail Roads yield, in conformity with the grand idea of their establishment, only the interest and sinking fund of their capital, but the State Treasury has, by the increase of intercourse, indirectly, gained in all taxes, in the revenue from tolls on turnpike roads, and from the mail; the most important gain, however, was that kept in view by the great founder of these roads, to bring the nation into a more intimate contact, and to form of it one large family, on which the actual national device: "L'Union fait la force," ("Union gives strength,") becomes realized.

F. A. Chevalier de Gerstner.

*** Letters to whom may be addressed to the care of Messrs. Maitland, Kennedy & Co., New York.

☞ Five francs and thirty-three French centimes are equal to one dollar. One English mile is equal to one thousand six hundred and ten mètres. One pound sterling is equal to four dollars eighty-six cents.

Cincinnati, 25th June, 1839.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1838, *With Remarks and Exemplifications by the Editor.*

1. For a machine for *Sawing Shingles;* Elnathan Samson, Plymouth New Hampshire, September 5.

In this machine the sawing is to be effected by a circular saw; the machine, generally, is like a number of others for the same purpose, the claim being confined to the particular construction of the parts concerned in setting the shingle bolt so as to cause a head and point to be alternately sawed.

2. For an improvement in the *Pistons of Steam Engines;* Ellis L. Norton, Hartford, Connecticut, September 5.

(See Specification.)

3. For an improvement in the manner of constructing *Boilers for Generating Steam;* Ellis L. Norton, Hartford, Connecticut, September 5.

(See Specification.)

4. For an improved *Protracting Table,* for Engineers, Surveyors, &c.; William T. Steiger, Washington City, September 7.

This protracting table, which is the work of a practical draughtsman, is well calculated to effect its object, and the assertion of the inventor is undoubtedly correct, "that any line in or about a circle may be projected and correctly measured on the draughting board, and any number of points ascertained in any curve whatever, of which the chords, and their included angles, can be calculated, by actual protraction, with a degree of accuracy and despatch not hitherto attained by the instruments in common use." The description and illustration of the instrument occupy many pages, referring to several drawings.

The claims are to "the manner of connecting the protractor arch, having a fixed centre pin, with a revolving draughting board, and with the parallel and guide strips, regulated in the manner, and for the purposes set forth."

5. For an improved *Spring Draft and Bumpers, for Rail Road Cars;* Peter Alverson, New Haven, Connecticut, September 8.

The patentee informs us that the object of his invention is "to prevent the jerk usually experienced in the first movement of connected cars, and the jar occasioned by the concussion when suddenly stopped, by interposing elastic chains, or spring drafts and bumpers, both made with strong spiral springs, as described, thereby preventing, or greatly lessening, the effect both of the jerk and of the concussion."

The elastic chain, or spring draft, consists of an apparatus of strong spiral springs coiled around stationary, and sliding rods under each end of the car; the chains, or links, by which the cars are connected, being attached to the sliding part of this apparatus, will necessarily, to a certain

extent, produce the intended effect. The bumpers, or elastic cushions, are to be attached in the usual manner to the front and rear draw bars of the carriage bed of each car, and these also are to derive their main elasticity from similar spiral springs, coiled upon rods of iron in their rear. The claim is to "the combination of spiral springs with the other machinery, as specified."

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6. For an improvement in *Fire Plugs and Hydrants;* John M. Jorden, Baltimore, Maryland, September 8.

Various plans have been devised for the purpose of letting off the waste water of a hydrant, to prevent its freezing, and that before us can scarcely be called an invention, it being merely a modification of the ordinary mode, namely, the turning a cock below the surface of the ground, which, whilst it cuts off the supply from the water pipe, allows that contained above said cock to run out, and to be absorbed by the earth. The claim made is to the "particular manner" of arranging the part by which this is effected.

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7. For *Applying Electro Magnetism as a Motive Power;* Solomon Stimpson, City of New York, September 12.

It has been satisfactorily ascertained by numerous and well conducted experiments, in the hands of persons of competent scientific knowledge, that the attainment of an available motive power by the electro magnetic influence, is a thing not to be hoped for, in the present state of our knowledge upon that subject; and that although we have much to learn concerning this agent, we have no ground, by reasoning from what we do know, to justify the hope that the steam engine will eventually give place to the electro magnetic power. After this it is hardly necessary to remark that all the instruments hitherto constructed for this purpose have proved to be failures, so far as practical utilitarianism is concerned. That before us depends for its action upon a change of poles, in a manner common to most of its compeers; but it was thought that the particular arrangement of the parts, presented sufficient novelty upon which to base a claim, and a patent was therefore granted for it; but this will not protect it from the fate which has overtaken, or awaits, the whole brotherhood. A year ago, applications for patents, were numerous, and many caveats were entered, for the purpose of protecting the inventors of such machines, but many months have passed over, as we believe, without any new device having been offered, and we are glad of it, because we think that those who might be induced to continue such attempts for profit, would be destined to encounter certain loss.

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8. For an improvement in the mode of *Fastening Bedsteads;* Laurens Kent, Dorset, Bennington county, Vermont, September 12.

The rails of the bedstead are to be halved, or lap jointed together, and the posts are to be in two parts, one of which is to have a screw upon it, which is to pass through a hole in the middle of the lap-joint—and this is to screw into the opposite section of the post. This mode of fastening is the thing claimed, but we much doubt its being extensively adopted.

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9. For a machine for *Shelling Corn;* Rufus Porter, Billerica, Middlesex county, Massachusetts, September 12.

It rarely happens that we meet with a machine intended to effect some object to which numerous others have been applied, which does not belong

to one or other of the families into which they may generally be divided, but we have here a corn shelling machine which we believe to be *sui generis.*

A pulley, or wheel, is made to revolve, which has a hollow shaft, or centre, the opening through it being sufficiently large to admit an ear of corn to pass freely. Three straps of steel are bent so as to form elastic springs, one end of each of which occupies a part of the opening in the shaft of the pulley, passing each other so as to form a triangular aperture in the middle of the opening. A hook, or tooth, is formed upon the end of each of the springs, and when the corn is fed in between them, these hooks, or teeth, separate the grain from the cob, the elasticity of the springs adapting them to ears of different sizes. As the cob passes through, it is seized between two revolving cylinders furnished with teeth, which draw it forward. The claim is to the "construction of the shelling wheel as above described, and in combination therewith, the shafts having spikes on their surface, in the manner, and for the purpose described."

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10. For a machine for *Removing Snags and Sawyers from the beds of Rivers;* Henry M. Shreeve, St. Louis, Missouri, September 12

This machine, which has performed good service on the Mississippi and other rivers, consists of two steam boats so connected together as to form a twin boat, each division of which is furnished with a powerful steam engine, and propelling wheels of the ordinary construction. Near the forward end of the two boats there is what is called a snag-beam, made of great strength, and armed with iron; this is firmly connected to each boat, and is the instrument by which the trees are to be raised, or broken off. For this purpose the boat is put under full way, and so directed as to bring the snag-beam forcibly up against the tree, which is sometimes broken off and floats away, and is sometimes raised from its hold on the bottom, in which case it is drawn up by means of powerful windlasses, worked by the steam Engine, and deposited on a cradle formed between the two boats, where it is cross cut, and then thrown into the water, to float off.

The claims are to "the manner of combining and connecting the mechanical power of the windlass and the pulley, so as to co-operate with the momentum given to the twin steam boat, and with the continuous action of the paddle wheels, so as to break off, uproot, and raise, snags and sawyers, as above set forth. I, however, particularly claim as new, the application of the snag-beam, for the purpose of raising or breaking the snag, or sawyer, preparatory to its being lifted on board the boat by the apparatus constructed for that purpose. I also claim the manner of connecting together the two boats by means of the upper and lower tier of beams, diagonal braces, bulk head, and the forward beam."

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11. For improvements in a *Machine for Rolling, Shaving, Softening, and Finishing, Leather;* Thomas Chace, City of New York, September 12.

The leather to be rolled, &c. is placed upon a concave bed, where it is held by clamps, and the roller, or tool, which is to pass over it is connected to a vibrating frame, swung like the lathe of a loom. The lower bar, called the traverse bar, of this frame, allows the apparatus carrying the roller to be slid along it, so as to act upon all parts of the concave bed.

Rolling machines operating in a manner somewhat resembling that before us are not new, and the claims in the present case are limited, therefore, to

the peculiar manner of constructing certain parts of the apparatus, namely to a spring lever by which the roller and traverse bar are governed, in combination with said traverse bar.

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12. For an improved *Summer and Winter Cooking Stove;* Philo P. Stewart, City of New York, September 12.

The description of this stove is of considerable length, setting forth its construction and supposed advantages; and the sectional and other drawings extend to seventeen figures. To adapt it to summer and winter use there are several parts which are to be changed, so as either to confine the heat, or to suffer it to escape into the room. It is likewise to be adapted to the burning of either wood or coal. The patentee claims "the arrangement and form of the fire place, as combined and acting within the oven; and the arrangement and action of the heating flues," and of several other parts, not to be understood by the mere announcement of them, and not presenting any thing very distinctive in character.

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13. For an improvement in the mode of *Attaching Sleigh Runners to wheel Carriages;* Henry G. Guyon, City of New York, September 13.

The wheels of two, or of four, wheeled carriages are to be secured upon runners, by means of substantial clamps, and the claim is to "the attaching of sleigh runners to wheels of carriages in manner substantially as described." We cannot furnish any particulars of the invention, as we do not find any thing particular in it; most workmen could devise ways of effecting the same purpose equally original and meritorious with those pointed out; the difficulty will be in getting the thing into use so as to be paid for it.

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14. For an improved *Cooking Stove;* Philip Wilson, Springfield, Hampden county, Massachusetts, September 13.

The claim made under this patent consists in the particular manner of giving a curvature to the grate bars, and to the combination of the respective parts of the stove as a whole.

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15. For an improvement in *Wind Mills;* Israel Keyes, Putney, Windham county, Vermont, September 14.

This wind-mill is to have a wind wheel consisting of vanes, or wings, placed upon a vertical shaft, and this is to be enclosed within a cupola of vertical slats turning upon pivots at each end, so that the apertures between them may be increased or diminished according to the force of the wind; the opening and closing of the slats are to be effected by a governor, which may be made to act by centrifugal force, like those most commonly used in steam engines, wind mills, &c.; when water is to be pumped up by the mill, a simple, but ingeniously constructed, water governor, which is described, may be used, its action depending upon the quantity of water raised by the mill. The claim is to the application of a regulator to the wind mill by means of a cupola of blinds, the slats of which are movable on their axes; the whole being combined and operating as described."

The self regulating action has been applied to wind mills of various kinds, and in various ways; the novelty, therefore, consists in the application thereof to this particular kind of mill, in the manner set forth.

16. For a *Boat for Traveling on Ice;* Thaddeus Chapin, Canandaigua, Ontario county, New York, September 14.

Boats with sails, and runners for traveling upon ice are well known devices, but the boat here described is to have paddle or propelling wheels in addition to runners, the peripheries of said wheels being armed with spikes to take hold on the ice. They are also to operate as propelling wheels in case of the breaking of the ice. The motive power may be steam, or any other which is preferred.

The claim is to "the combination of a boat, or other water-tight body, supported on sleigh runners, with a shaft, and wheels roughened on their treads, turned by steam, or other, power, for propelling the same over ice."

Such a boat may no doubt be made to travel upon ice; but possibility, and eligibility, are not always companions, and we apprehend that in the present case they will not be found to coalesce, even on our northern lakes, and in long protracted winters. The objections and difficulties are so numerous and palpable that they need not be urged.

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17. For an improvement on the *Rag Duster*; Enoch Burt, Manchester, Hartford county, Connecticut, September 14.

This duster resembles that in use in having a centre shaft furnished with pins, or beaters, and with stationary pins projecting inwards from the interior of its periphery; but in addition to the centre shaft there are two others midway between it and the periphery of the duster, which shafts have similar pins, or beaters, projecting from them. To these latter shafts a rapid vibratory motion is to be given, which is effected by placing a spur wheel on the centre shaft immediately outside of one of the heads of the cylinder, and allowing a pinion to gear into this wheel, which pinion carries a crank pin, connected by rods with cranks on the ends of the two auxiliary shafts. The claim is to these auxiliary shafts, or bars, extending through the duster, and causing the pins in them to vibrate, or reciprocate, between the stationary pins both in the shaft and ribs; and their combination with the common duster, as set forth.

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18. For a machine for *Grooving, Moulding, and Sawing Boards;* Frederick Fredly, Sugar Valley, Centre county, Pennsylvania, September 15.

In this machine the cutters which are to form beads, mouldings, tongues, or grooves, and by which sawing also is to be effected, are to be placed upon revolving shafts turned by means of a winch. The frame work of the cutters is to be a traveling carriage which is to run upon ways, the board being stationary and clamped firmly so as to be acted on by the cutters. "The invention claimed and desired to be secured by letters patent, consists in the mode of tongueing and grooving, and beading boards, &c., by means of revolving cutters which work in a frame that travels on ways between which the boards to be operated upon are clamped; said frame having a gauge to regulate the cut of the cutters."

It is a very easy task to construct a machine upon paper, and to tell how it will operate, but a practical trial frequently gives entirely new views of the matter, and such we apprehend will be, or has been, the history of this machine. To form correct cutters for mouldings, which shall operate upon the periphery of a wheel traveling in the way described, is no easy matter,

and we are of opinion that, in most cases, the hand of the workman would be found far preferable to the proposed machine.

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19. For an improvement in the *Plough;* David Prouty and John Mears, Boston, Massachusetts, September 15.

The improvements in this plough which form the subject of claims, are the manner of affixing and protecting the point of the coulter. The manner of applying the locked coulter by an opening on the land side, and the manner of applying the brace so as to secure the beam and land handle, unite with the mould board handle, and adjust the position of the beam.

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20. For a machine for *Extracting Stumps and Raising heavy Bodies;* Roswell H. Hall, Branchport, Yates county, New York, September 15.

A platform fixed upon runners, or skids, that it may be moved about from place to place, has a vertical iron bar rising from its centre, its upper end being supported by a gallows, and revolving on gudgeons at either end. Said bar may be three inches in diameter, and it has a loop, or eye, at its upper end, to admit a strong lever, or sweep, by which it is to be turned, thus constituting it a vertical windlass. The two ends of a rope are to coil round its lower part, and pass through pulleys which are connected to two opposite stumps, or other resisting bodies, when by turning the shaft one of them is to be removed.

The claim is to the above described arrangement of ropes and pulleys in combination with the windlass.

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21. For a process for *Alloying Metals by Cementation;* M. Sorel, Paris, Kingdom of France, September 17.

(See Specification.)

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22. For a machine for *Cleaning Wool from Burs, &c.;* Theodore Ely, Poughkeepsie, Dutchess county, New York, September 17.

"The wool to be cleaned, after being assorted in the usual way is fed by hand to the machine, in which it passes between a pair of rollers, which I prefer to make of copper, although they may be made of any other metal, or even of wood; but there appears to be a peculiar adaptation in the texture of copper, so far as my experience has extended. The uppermost of these rollers is borne down by a spiral or other spring which enables it to adapt itself to the varying thickness of the sheet of wool passing between the pair.

"To remove the burs from the wool as it passes between the rollers, I employ a plate, or blade, of steel, which stands in front of the upper roller, its lower edge being nearly opposite to the line of junction of the two rollers, and its back side nearly touching the upper roller. This plate is made adjustable, sliding up and down in grooves, which receive its ends; it does not stand vertically, but is inclined from its upper edge towards the rollers.

"The lower edge of the steel plate is to be turned by a burnisher, like a currier's knife, which will have the effect of enabling it to catch against the burs, &c. A revolving fan, back of the rollers, blows off the wool as it passes through."

The claim is to "the use of the steel plate, or blade, with its lower edge

turned as above described, and operating in combination with the metallic or other rollers, for the purpose and in the manner set forth."

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23. For a machine for *Thrashing and Winnowing Grain;* Reuben W. Currier, East Kingston, Rockingham county, New Hampshire, September 17.

The thrashing part of this machine does not present any thing particular, but consists of a cylinder set with teeth, and working into a concave similarly armed. The novelty consists in the particular manner of forming and arranging the endless belts for carrying off the straw, and for riddling the grain. There is what is denominated a conductor situated below and back of the thrashing cylinder, up which the straw passes to an endless belt by which it is carried off, the grain falling through its meshes upon a second endless belt, and being acted on by a fan wheel. There is more novelty of form than substantial difference from others, in this machine. The claim is to "the conductor in combination with the two carrying belts."

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24. For a machine for *Tearing and Dusting Rags,* and other materials used in the manufacture of paper; Henry Clarke and William Albertson, New London, Connecticut, September 19.

There are to be one or two shafts of circular saws, fixed in the manner of those for roller gins, the saws being about two inches in diameter, and half an inch apart; these are made to revolve so as, by the aid of combs, to tear the rags, whilst revolving brushes serve to keep the saws clean; a screen under the whole serves to aid in separating the dust. The rags are to be fed up between rollers, by the aid of an endless apron.

Claim.—"We claim as our invention the aforesaid combination of the shaft and circular saws, and blocks, when combined with the combined fans and brushes, and the feed rollers and apron, and the screen and comb by which the rags are torn, dusted, and prepared for the engine."

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25. For an improved *Eccentric Brake, for arresting the motion of Railroad Cars;* Ephraim Morris, Bloomfield, Essex county, New Jersey, September 19.

Between the two wheels on each side of a car there is to be a cam wheel, one part of which is to be a segment of a circle, resembling the periphery of one of the wheels; another portion of the periphery of the cam is in a straight line, probably of two feet or more in length, and the cam may be made to roll round on its circular, or curved part, and to bring this straight part upon the rail, which, whilst it bears upon it, will lift the wheels, at one or both ends, therefrom. The straight portion of the cams are furnished with flanches which embrace the rail. This part by its friction upon the rail is to operate as a brake upon an inclined plane, or elsewhere. The claim is to the foregoing arrangement of the respective parts.

When it is desired to relieve the brake, this is effected by backing the cars, when the ordinary wheels are made to rest upon the rail, the lower side of the brake being then free from them; there are, of course, some particular devices described which we have not noticed, nor do we think it necessary, being apprehensive that the contrivance is not destined to be adopted.

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26. For an improvement in the *Mortar for Dressing Rice;* Jamie-

son Cordes, a citizen of the United States, residing in London, England, September 19.

This patent is taken for an improvement in the mortar employed in dressing, or redressing, rice; the patentee says:—"now, whereas the mortars heretofore used in dressing rice or paddy, have been made as smooth as possible inside, which I have found does not dress the grain either so quickly, or so well, as when the inside of the mortar is rough, or so formed as to prevent the grains next to the side of the mortar from slipping upon the down stroke of the pestle, as readily as those at a distance from the sides of the mortar. And whereas many means may be adopted for making the inside of the mortar rough, or uneven enough to obtain the object, I therefore claim, as my invention, a mortar for dressing rough rice, or paddy, or for redressing rice, the interior surface of which is formed as hereinbefore described, or otherwise formed with recesses or impediments, or made rough or uneven, in such manner as to effect the object hereinbefore explained, namely, of more effectually causing the detention or partial detention, of the outer grains from ascent, in order that they may be rubbed against by the inner ones the more effectually, during the action of the pestle."

In the drawing, that part of the mortar which is occupied by the upper portions of the rice, is represented as formed into angular ridges, the vertical section of which would be like saw teeth.

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27. For an improved *Cooking Stove;* Jordan L. Mott, City of New York, September 19.

This stove in its general form, resembles the old fashioned ten plate stove, but differs from it materially in its interior arrangements. The claims are the following:

"My claims consist in making the bottom, sides, and flanches of the fire box, in one single piece, for the purpose of preventing the warping of the plates, and the escaping of ashes into the oven. I claim the particular manner of conveying the draught round the oven, so as eventually to carry it up in front on each side of the fire place door, in divided flues. I claim the manner of constructing the air heating flues on each side of the fire box, in connexion with the mode of admitting it into, and of allowing it to escape from, the oven."

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28. For a machine for *Cutting the Teeth of Circular Saws;* Thaddeus Sellick, Haverstraw, Rockland county, New York, September 19.

One, two, or more, steel plates, prepared to have teeth cut upon them, are to be placed upon a vertical spindle capable of revolving on its two ends. These plates are to be made to bear against a revolving cutter, consisting of an endless screw, the thread of which is in such form as to cut a saw tooth. A cutter two inches in diameter and half an inch in thickness, has been used for the purpose. The revolution of the cutter will cause that of the saw plates, which are borne up against it. It is remarked that the teeth of straight saws may be cut by a similar device.

"What I claim, is the employment of a circular revolving cutter, having a thread or channel on its periphery, running in the manner of an endless screw, and so arranged and combined with the other parts of the machinery employed, as to cause the cutter to cut, and to feed the plates to itself, by its own action, the whole operating substantially in the manner above set forth."

29. For constructing and using *Fishing Seines;* Cyrus Tracy, Savannah, Georgia, September 19.

The nature of this invention is said to "consist in drawing a seine under the fish, or holding it in an extended position, till such fish as move at the surface of the water, and in a direction with the tide or current, shall have passed into it, when the seine is closed, and the fish secured." The claim is to the particular manner of using the seine, as described.

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30. For an improvement in the mode of *Covering the Roofs of Buildings with Sheet Metal;* J. B. Duval, City of Charleston, South Carolina, September 19.

"The object of my invention, is to lay on the tin plate in such a manner as shall allow a free expansion and contraction of the metal, whilst the whole covering is effected without the use of solder in any part, or the driving of nails through any of that portion of the tin which constitutes the covering." It is stated that the mode adopted by the patentee is analogous to some which have been previously known, but "the difference of my mode of procedure and that in which the edges of the tin are curved up, and slit tubing is passed over them, or other analogous means of allowing for expansion and contraction will be apparent, as I allow for it effectually with all the seams closed down by the mallet."

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31. For an improvement in the mode of *Preserving Timber;* Edward Earl, Savannah, Georgia, September 20.

We published in our last number, the specification of a patent for a similar purpose, the gentleman above named being one of the patentees. The mode of procedure in the present case is like that described in the former patent; that is, the timber is to be boiled in the solution by which the preservative quality is to be communicated, which solution is to consist of sulphate of copper, (blue vitriol,) and sulphate of iron, (copperas,) dissolved in water. One part of sulphate of copper to three of sulphate of iron, are to be taken, and about three pounds of the mixed salts added to every gallon of water. The timber after being bored through its length, is to be boiled, and afterwards suffered to cool in this solution. The claims made, are to "the boiling of timber as described, in a solution of sulphates of iron and of copper; applying this solution to the interior as well as the exterior of the timber, by means of the central perforation when the size of the timber requires it, as the most effectual mode of protecting it from the ravages of insects, and of rot. I do not claim the saturating of timber by a solution of sulphates in water when applied cold, but confine my claim to boiling it, as above set forth, in that solution, during from two to five or six hours, or more."

We think that most of our remarks on the former patent, are equally applicable to that before us.

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32. For a machine for *Sticking Sash Stuff;* Caleb B. Rogers, Norwich, Connecticut, September 20.

The sticking is to be effected by revolving cutter wheels, the stuff being held, and advanced against the cutters by suitable means; in which there is but little of novelty, the form and construction of the cutter wheels, constituting the entire claim. The patentee has probably secured the right to

his peculiar manner of constructing this part, so as to hold the cutters, but other arrangements equally good, may be readily devised.

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33. For an improved mode of *Setting Sugar Kettles;* James Malory, New Orleans, Louisiana, September 20.

This patent is taken for substituting rings of cast iron, in place of the bricks usually employed in forming the projecting ridges between, and surrounding sugar kettles, in the ordinary mode of setting them. The claim is to "the employment of rings of cast iron in the setting of sugar kettles, as set forth."

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34. For a *Mortising Machine;* Erastus M. Shaw, City of Baltimore, Maryland, September 22.

There are so many patented mortising machines, that nothing is left for new ones but to vary the modes of making the adjustments for holding the stuff, advancing it, and working the chisels; and these minor arrangements are rarely of sufficient importance to merit particular description. Such is the case in the present instance.

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35. For a *Paddle Wheel;* Isaac McCord, Harrisburg, Pennsylvania, September 22.

A number of inconveniencies and bad properties are ascribed to the ordinary paddle wheel, which the one now patented is intended to obviate. To some of the evils complained of, we do not admit the ordinary wheel to be liable, nor do we perceive the utility of all the so called improvements in that before us. We are told that the bucket which has last entered the water, leaves but little for the next bucket to act upon, as it forms a hollow space, by scooping the water out of the way; now if the boat were not making progress, something like this might occur, but in a boat that is under way, the successive paddles enter a new portion of the fluid. But we have not space for such discussions. In the wheel, which is the subject of this patent, the part within the paddles is to be an enclosed drum, and the ends of this drum, or heads of the wheels, are to form projecting rims extending out to the edges of the paddles. Between each paddle, there is to be a fluted roller extending from head to head of the wheel, which, among other good works, is to prevent ice and drift wood from getting between the paddles; the main object, however, of said rollers we do not understand, as they are placed, it is said, "for the purpose of excluding air in part from the buckets, in order that they may more completely fill with water."

The buckets are to be "prismoidal," that is to say, thicker at their inner than they are at their outer edges, that they may have the less tendency to lift water; and they are to be defended by bars of iron bent into a semicircular form, and stationed around the lower part of the wheel.

"The invention claimed, and desired to be secured by letters patent, consists in the combination of a wheel for propelling steam or other boats made of plank, or iron heads or ends, and a circular rim with prismoidal paddles, and fluted rollers placed between them in the manner and for the purpose above set forth; and also the arrangement of the semicircular ribs of iron for protecting the wheels, as above described."

36. For a machine for *Cleaning Feathers;* Samuel G. Ladd, Hallowell, Kennebec county, Maine, September 22.

The feathers are to be introduced into a double cylindrical case; the space between the two cylinders is to be filled with steam, and the feathers within agitated by a revolving shaft furnished with rods, or beaters. One end of the cylinder is to have a movable head, and the claim is to "the movable head; by removing which, I am enabled to cool and receive the feathers after the operation of cleansing is over." This is rather a small claim, as a door in the bottom would, we think, answer the end proposed; but numerous feather dressers had been previously patented, and these, we suppose, had run away with the whole invention, with the exception of this movable head.

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37. For a machine for *Hulling Rice, Barley, &c.;* Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, September 22.

A vertical, cylindrical vessel is to receive the grain to be hulled, and this vessel has in it a revolving shaft which carries metallic arms, there being similar, but stationary arms projecting inwards from the vessel. A lid, or cover, is to be forced down by a screw so as to subject the grain to any degree of pressure required, and the shaft is then to be put in motion. The claim is to "the agitating of rice or other grain to be hulled by revolving and stationary arms, whilst the grain is subjected to a considerable degree of pressure in a cylindrical, or other suitably formed vessel, in a manner substantially the same with that herein set forth."

When we first saw the model of this machine, we thought the proposed plan to be one of great feasibility, and hoped much from it. The idea of hulling in this way we thought new, and still believe that it is so; the project however, has been fairly tried, and has proved a failure, and a really good rice hulling machine is still, therefore, a desideratum; all those in use being chargeable with certain defects.

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38. For a machine for *Sawing Shingles;* William Bell, Lexington, Kentucky, September, 22.

The timber is to be cut into proper lengths for a shingle, and a block so prepared, is to be placed in a box of a particular construction, by which it is held, and presented to the saw, which is stretched in a frame working between fender posts, the plane of the saw being parallel to that of the frame. The manner of holding the block, and of shifting it so as to cut heads and points, would require too many words for its description, but the whole exhibits considerable novelty. The claims are confined to the particular manner of constructing or operating the respective parts, and would not, without the drawing and description, convey any distinct idea of them.

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39. For an improved *Gas Meter;* Samuel Clegg, City of London, Great Britain, September 22.

We must refer the curious in this matter, either to the English journals, devoted to the publication of patents, or to the patent office, for particular information. Mr. Clegg was a pioneer in the construction of gas meters, and much is due to him for the skill which he has manifested in the prosecution of this business; the original and the present meters are, as might well have been anticipated, essentially different from each other. The claim will render this manifest to any one acquainted with the old meter.

"I claim exclusively the instrument or combination above described, for measuring gas, composed of one or more balances, formed of one pair, or several pairs of globular or other shaped vessels, each pair being united by a tube and partly filled with alcohol or any other fluid which boils at a low temperature, and submited to the action of jets of gas at different temperatures; this gas being heated before it arrives at the vessel, containing the said balances, by a flame of gas, or by any other convenient means."

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40. For a machine for *Sawing Shingles and Clapboards;* Thomas J. Flanders, Bradford, Merrimac county, New Hampshire, September 22.

The history and mystery of this machine are really too long for its subject, and the more especially so as the matters of fact contained in it are not new in themselves, whatever of novelty they may possess in their particular arrangement. The shingles and clapboards are to be cut by a circular saw, and the matters described are principally those concerned in holding and shifting the stuff, so as to cut heads and points, and thick and thin edges.

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40. For a *Permutation Lock for Doors, Vaults, &c.;* Robert Newell, City of New York, September 25.

The general description of this lock, would serve for a considerable number of others, as there is "a combination of slides and tumblers operating together on the bolt, in such manner that they can be transposed or set in any given position to which the key may be formed, the bit of the key being composed of as many movable sections as there are slides in the lock." The claims relate, of course, to the particular manner of constructing, arranging, and changing the movable, or permutation portions of the lock, which is not a thing for verbal description. We have examined one of these locks, which was made in a manner to do great credit to the skill of the workman, whilst the arrangements were such as promised permanence, and seemed fearlessly to throw down the gauntlet to the picker of locks.

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42. For *Metal Combs;* Richard A. Ives, Bristol, Connecticut, September 25.

A strip of sheet metal is provided, of a width equal to that of the intended comb, and of a thickness equal to that meant to be given to the teeth; this metal is to be bent, or plaited, in a zig zag manner crosswise, the bends being of such width only as shall adapt them to the forming of a single tooth; this crumpling, or bending, may be effected in the first instance by rollers, resembling crimping rollers; these plaits are then to be pressed up together, whilst a similar piece is interposed between each plait, to form the spaces between the teeth; this being removed, ribs are to be soldered on each side of the crumpled plate, to form the middle or back of the comb; the metal on each side is then to be cut away, to liberate the teeth, and the comb is to be finished up by filing, buffing, &c. The claim is to the foregoing mode of forming metallic combs.

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43. For a machine for *Sawing Staves;* William Lacy and Solyman Merrick, Springfield, Hampden county, Massachusetts, September 25.

This machine is a modification of what has been called the barrel saw,

which consists of a barrel-formed metallic body, one end of which is furnished with saw teeth, for the purpose of cutting the stave into the proper form; a body of this kind is made with difficulty, and for barrels of the ordinary size is too long to run steadily, at the distance of the teeth from its bearing. In the case before us there are two such saws, each of them being of the length of half of the barrel only. The patentees say, "the nature of our improvement consists in the use and application of two hollow conical saws, of about half the length of the stave to be sawed; these saws commence sawing at each end of the block or stave, and proceed sufficiently near to the centre to separate the stave from the block. The objects to be attained by our improvement are as follows; to reduce the amount of timber wasted by the cut of the saw, by reducing the thickness of the plates of which the saws are composed in proportion to the reduced length of the saws; and also to reduce in like proportion, the amount of power necessary to saw a given number of staves; also to saw staves with great facility."

The details of the manner of working the two saws, and of holding and advancing the timber, are clearly given and represented; these, however, any competent machinist could readily devise, the merit of the invention consisting in the two saws. The machine is in good hands; we are not, however, informed respecting its operation, but are inclined to think well of it.

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44. For a machine for *Dyeing Yarn from the Beam;* William Spencer, Lowell, Massachusetts, September 25.

By means of the apparatus described, the yarn is wound from one yarn beam to another, and in its passage is conducted, over rollers, down into a vat containing the dye, within which vat it passes under a drum, or slatted reel, and in emerging from the dye, the yarn passes between squeeze rollers, and over a drying cylinder. "By changing the application of power from one of the beams to the other, and back, the yarn may be passed forwards and backwards through the dye any number of times that may be required." Each separate thread of the yarn occupies a groove in a roller, as it passes backwards and forwards.

The claim is to "the combination of the slatted reel with the reeds, grooved rollers, and squeeze rollers, and steam cylinder, and the application of said combination to the beam of yarn, for the purpose of passing the yarn through a dye vat, and dyeing and replacing it on the beam."

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45. For an improvement in the *Flyer* for spinning flax, hemp, manilla, &c.; Henry Evans and Barnabas Churchill, Plymouth county, Massachusetts, September 26.

"The invention is two regulators for spinning at a given rate, introduced within the flyer of a spinning machine, as shewn in the drawing." The claim is to "the application of these two regulators within the flyer of a spinning machine, as herein described, for regulating the spinning of all kinds of hemp, flax, and manilla." The regulators consist of small drums, &c., around which the yarn passes, but the detail of their construction, and mode of action, cannot readily be shown without the drawings.

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46. For a *Roller Gin*, for Ginning long staple, and other cotton; Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, September 27.

The ginning rollers of this machine are usually made of metal, and they have ridges and depressions running their whole length, like the threads of a many threaded screw. They are placed horizontally in pairs, in such manner as that the ridge of one roller shall enter the depression of its fellow; these rollers are to be driven by whirls, or by any suitable gearing.

Several modifications of this roller gin are described, and a claim is made to "the forming of spiral channels upon the rollers of the roller gin for ginning cotton."

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47. For a rolling mill for *Rolling Circular Saws, Saw-gin Plates, &c.;* Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, September 27.

This rolling mill is intended principally for rolling the plates of cotton-gin saws, which saws are composed of two semicircular plates, which when put together form the circular saw, with a large opening in the centre, for the shaft. The rollers are two steel cones on the ends of two shafts, geared together by bevel wheels in a suitable frame. By passing the steel plates between these rollers they will be unequally stretched at their two edges, and may be made to assume the required form. The claim is to "the combination of the conical rollers with the gauge plate, as described."

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48. For *Extracting Colour from Dye Wood;* Laurens Kent, Dorset, Bennington county, Vermont, September 27.

(See Specification.)

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49. For an improvement in the *Apparatus for making Coffee and Tea;* Antoni Bencini, Milton, Caswell county, North Carolina, September 27.

The claim is to "the construction and use of an apparatus for making coffee or tea, in which there is a receptable for cold water for condensing the aromatic portion which escapes from the heated vessel."

A coffee pot is made of tin, &c., in the ordinary form, and the coffee is to be boiled in this pot, as usual, but only in about two thirds of the quantity of water to be employed; over the hind part of the coffee pot is a barrel-shaped receptable into which the remaining third of the water is to be put, cold. A tube with a stop cock, leads from the bottom of this receptacle into the coffee pot, and on the upper side of it there is an opening into which passes a tube which leads from the top of the coffee pot into the cold water, passing down near to its bottom. When the coffee is boiling the steam is conducted through this tube, and eventually brings the cold water to the boiling point, which will be known by the escape of steam from the upper opening; the pot is then removed from the fire, the stop cock turned, and the water from the receptacle allowed to run into the coffee pot, charged, it is said, with the aroma which is ordinarily lost. During the boiling the spout of the coffee pot is closed by a cork.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for an improvement in the Pistons of Steam Engines; granted to ELLIS L. HORTON, *Hartford, Connecticut; September 5th,* 1838.

To all whom it may concern: Be it known, that I, Ellis L. Horton of the City of Hartford, in the county of Hartford, and State of Connecticut, have

invented a new and improved mode of constructing the pistons of Steam Engines; and I do hereby declare that the following is a full and exact description thereof.

My improved piston is of the kind which is intended in general to operate by means of an expanding metallic packing, but my improvement is not necessarily confined to those pistons with a metallic packing but may be employed in all cases where it is desired to cause the elastic force of the steam to act within the body of the piston, and force the packing against the cylinder. My improvement consists in the employment of two valves, one on the upper and one on the lower plate of the piston, when used in a vertical cylinder; each of these valves opening inwards so as to admit steam to pass in freely on either side where its pressure may operate, and to prevent its escape at the opposite side.

Fig. 3. *Fig.* 2. *Fig.* 1.

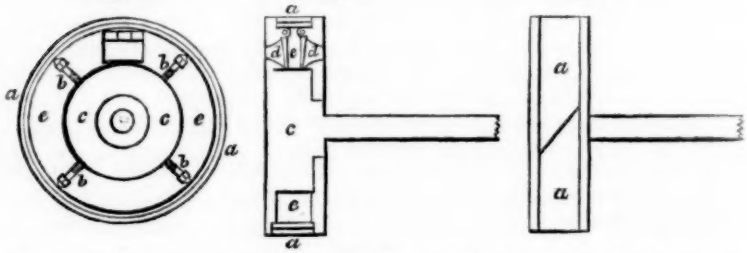


Fig. 1, in the accompanying drawing, is a side view of said piston for a horizontal engine. Fig. 2, is a vertical section through its middle, and fig. 3, a view of the interior, the front plate being removed: *a*, *a*, are hoops, or flat rings, of steel, or other metal, one within another, divided so as to allow them to adapt themselves by their elasticity to the interior of the cylinder; *b*, *b*, fig. 3, are set screws which are intended to keep the segments of the interior hoop, when divided into segments, in place, they are tapped into the hub, or centre *c*, *c*, of the piston.

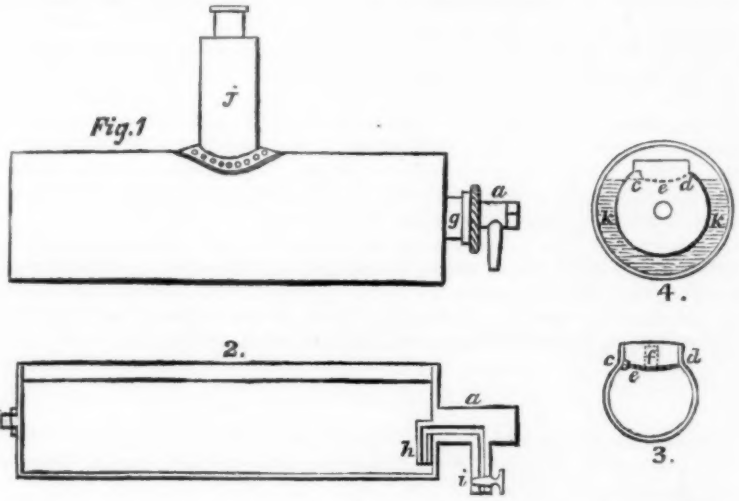
In fig. 2 and 3, *d*, *d*, are the valves opening inwards, one of them only being shown in fig. 3; the other being attached to the front plate; *e*, *e*, is the chamber within the piston into which the steam is admitted, and within which it acts upon the interior of the packing, forcing it against the cylinder, and counteracting its tendency to pass between the two.

What I claim as constituting my invention, is the employment of two valves, one in the upper or front plate, and the other in the lower or back plate, of the piston, to admit steam on either side, in the manner and for the purpose herein set forth, without confining myself to the particular form of the valves, or to the position of the cylinder, whether vertical or horizontal. ELLIS L. HORTON.

Specification of a patent for an improved Steam Boiler; granted to ELLIS L. HORTON, *Hartford, Connecticut, September 5th,* 1838.

To all whom it may concern: Be it known, that I, Ellis L. Horton, of Hartford, in the county of Hartford, and State of Connecticut, have invented certain improvements in the manner of constructing boilers for generating steam, and I do hereby declare that the following is a full and exact description thereof.

The exterior form of my boiler is that of the ordinary cylinder, but within this I place what I denominate a movable steam reservoir, or chamber, which occupies a large portion of the space within the cylinder, but between which and the cylinder there is to be a stratum of water of three or four inches, more or less, which is exposed to the direct action of the fire upon the outer case, or cylinder; by which means, as experience has shown, the generation of steam is augmented, whilst the quantity of water to be carried is much diminished.



In the accompanying drawing fig. 1, shows the exterior of the boiler. Fig. 2, a side view of the reservoir. Fig. 3 an end view of the same, and fig 4, a cross section of the boiler, and of the reservoir within it.

The reservoir is suspended, centrically, within the cylindrical case, or boiler, by the shafts, or pivots *a* and *b*. The main body of it is cylindrical, as shown in the section fig. 3, on its upper side it is open from *c*, to *d*, which opening extends its whole length, and is of sufficient width to allow a man to pass into it from the man hole in the boiler, for the purpose of cleaning or repairing either the boiler or reservoir; there are projecting sides along the opening, as shown in the figures, and these are to rise so as nearly to touch the inside of the boiler. A concave lid, shown by the dotted line *e*, is hung on centres on one side, as at *c*, this is made of the same curvature with the reservoir, in order that it may be folded back within it, and occupy but little room. When raised up, it forms a channel to carry off any water which may foam over the sides of, and would otherwise pass into, the reservoir. A pipe rises from the lid *e*, and is shown by the dotted lines *f*; this prevents the running of water into the boiler through the opening, or openings, which must necessarily be left in it for the passage of steam. In boilers where the water does not foam, the lid *e*, may be omitted.

The shaft *a* of the reservoir is hollow, and passes through a stuffing box *g*, in the boiler head. It is made square at its outer end, where the requisite power may be applied to turn it round when required. A tube, or pipe *h*, *i*, passes through the hollow shaft, and is bent twice at right angles as

shown in the drawing; it reaches down nearly to the bottom of the reservoir at *h*, and has a stop cock at *i*, by which it may be opened or closed at pleasure; by means of this device an opportunity is afforded of blowing off any water which may accumulate in the reservoir from the condensation of steam, or from any other cause. *j* is the steam drum, and *k*, *k*, the water space between the reservoir and the boiler. In each of these figures like parts are designated by the same letters of reference.

It will be seen that the close approach of the sides of the open part of the reservoir, to the cylindrical boiler, will tend to prevent the passing of water into it, even where the foaming is considerable. I will remark, however, that if it is at any time preferred to use this boiler without employing the reservoir as a steam chamber, it may be advantageously done, water being allowed to rise in the reservoir to the ordinary water line of a boiler; and I have found that when so used steam is still generated with greater rapidity than in cylindrical boilers without such an appendage. When thus used the pipe *h*, *i*, may be employed as a supply pipe, and the water injected through it, will have much less effect in checking the supply of steam than when injected directly into the boiler.

Having thus fully made known the manner in which I construct my improved cylindrical steam boiler, I now declare that what I claim as my invention, and wish to secure by letters patent, is the construction and use of the movable reservoir, suspended upon pivots, or gudgeons, and made, and operating, substantially in the manner herein set forth.

ELLIS L. HORTON.

Specification of a patent for a process for Alloying Metals by Cementation; granted to M. SOREL, *of Paris, in the Kingdom of France, September 12th,* 1838.

To all persons to whom these pesents shall come, M. Sorel, of the Kingdom of France, gentleman, sends greeting. Be it known that I, the said Sorel, have invented, constructed, made and applied to use, a new and useful process for alloying metals by cementation, applicable particularly to the preservation of copper, iron, and other metals, and also operating a change in their outward appearance, and giving them more gloss; which process is specified in the words following, viz:

The said process consists in alloying the surface, or even the mass, of copper either with *zinc, tin, lead, or other metals more fusible than copper,* and capable of being alloyed with the same. These various metals may either be employed singly or in combination, but I have obtained the best results, in every respect, from the use of zinc alone. By an analogous process, I also alloy iron and other metals, as herein fully described and made known.

The mode of cementing zinc with copper may also be employed for the cementation of other metals: I begin by scouring the metal I wish to alloy, or cement; I surround it afterwards with pulverized charcoal and zinc. The zinc is prepared for that purpose by forming an alloy between the said metal and iron, which alloy may be easily reduced into powder. Zinc minutely divided by other means may also be employed.

The copper, thus surrounded, or covered, is placed in a furnace, where it is to be raised to a red heat, and the same temperature must be kept up during a longer, or shorter, period of time, according to the dimensions of

the pieces of copper operated upon, and the depth to which it is desired to operate the cementation. It it, however, proper that the operation should not last too long, as, on the copper, there might then be formed a coating of brass, which would be liable to corrode, and to produce verdigris; which defect may be obviated in two ways—1st, by stopping the operation before the alloying between the copper and the zinc be completely effected, and 2d, by sifting pulverized zinc over the substances which cover the copper, a few minutes before it is drawn from the fire.

In the process of cementation, just described, instead of the pulverized zinc, thin sheets of zinc may be substituted, or even lapis calaminaris. When it is not required that the cementation should penetrate deeply into the copper, this metal may be previously coated with zinc, according to the usual process of tinning, and then submitted to the cementing process as above described.

This process of cementation is applicable to all metals in the rough or the finished state, such as copper, brass, bronze, melchoir, or German silver, and is of much importance in metallurgy. Among thousands of applications, may be mentioned the preservation of the copper sheathing of ships, the preservation of medals and other precious articles of bronze, the cleanliness, and consequently the salubrity, of culinary utensils.

It is worthy of remark that zinc, which by itself is so easily corroded by acids, becomes quite proof against sulphuric acid in the cold state, let it be ever so concentrated, provided the cementation of zinc and copper be stopped at the proper point to avoid the formation of brass; while, on the other hand, zinc alloyed by fusion with one half, or one third, of its weight of copper is dissolved by sulphuric acid as rapidly as if it were pure and unalloyed.

The application to iron of the process of alloying by means of cementation is to be next explained: this process preserves iron from rust, and, moreover, gives to wrought, or to cast, iron, the appearance of gold, or of silver.

With an alloy of copper and zinc in different proportions, and by prolonging the operation, more or less a gold or silver colour is given to the iron operated upon. These colours are brilliant and lasting, and do not produce verdigris, and the metal resists the action of sulphuric acid more or less diluted with water. The process is as follows, and consists of two operations, which though analogous in their effects, are yet different from one another.

Firstly, the iron must be covered by immersion in the fused metal which is intended to be used as a coating: *secondly*, the iron must be alloyed by means of cementation, with the metal which has been thus made to cover it. This last operation, gives to the coated metal new properties, and renders its surface more smooth.

To coat iron with an alloy of copper and zinc, I melt about two parts of copper with three parts of zinc, and I dip in this alloy, while in a fused state, and covered with borax, or other suitable flux, the pieces of iron I wish to prepare. These pieces must be well scoured, or previously coated with zinc. If the pieces be very massive, they must be heated before being dipped in the fused metal. By way of lessening the quantity of borax necessary to the process, a saturated solution of this flux may be made, and brought to the boiling point, and the pieces are then immersed in this solution, before being introduced into the fused metal. When extracted from the melted metal, the pieces of iron will not have yet assumed the colour

of copper, and their surface will be rough, but a second operation imparts to them the proper colour, and removes the asperities.

The second operation is as follows: the pieces of iron which have been submitted to the first operation, must be covered with powdered charcoal, and exposed to a red heat, for a longer or shorter space of time, according to the colour and the result to be obtained. The iron is better preserved from rust when the operation is rapidly effected, but in that case the colour is not so good.

The pieces of iron must be drawn from the furnace along with the charcoal which covers them, and in that state immersed in water, and allowed to cool.

The second operation may be effected in a reverberatory furnace.

The same process may be modified so as to dispense with the previous coating of zinc given to the iron: to effect this, an alloy of zinc and copper is made with the same proportions of each metal, indicated for the first process. When cool, this alloy must be reduced to powder in a mortar, and a certain quantity of borax must be added. The pieces of iron to be operated upon, must be scoured, and covered with a greasy, or viscous substance, or merely wetted with water; they are next strewed with the pounded alloy and borax, and finally imbedded in powdered charcoal in the same manner as in the second part of the first process; they must be heated long enough to allow the excess of zinc to evaporate. It is easy to ascertain that the operation is terminated when only a small quantity of vapour escapes from the mass. The pieces of iron are then drawn from the fire and thrown, while red hot, and still covered with charcoal, into water. After this immersion, the iron is completely coated with copper, the brilliancy of which may be increased by dipping it into nitric acid containing a little soot: it may then be burnished, polished, and even gilded, exactly as if it were massive copper.

I shall finally describe a second modification of the process for alloying iron with another metal by cementation: first, scour the iron perfectly, immerse it in a solution of sulphate of copper, and let it remain therein during a greater or less period of time, according to the thickness of the copper coating which it is desirable to obtain; the copper precipitates on the iron, and when the covering is sufficiently thick, the pieces operated upon must be taken out of the solution and covered with very fine clay, softened in water; over this are strewed borax and zinc, pulverized and mixed together: instead of strewing borax and zinc powder in this way, a paste may be made with clay, borax and zinc powder, and the pieces of iron be covered with the same.

The pieces of iron are next to be buried in powdered charcoal, and exposed, during a few minutes, to a white heat. They may then be withdrawn from the fire, and they will be found to be covered with a coating of the alloy, containing a greater or less proportion of zinc, according to the proportion contained in the powder employed, and the duration of the process.

What I claim as my invention, and desire to secure by letters patent, is the manner herein described of cementing copper, and other metals, or mixture of metals, with zinc, in the manner, with the limitations, and for the purpose, set forth. I also claim the manner of protecting iron, by the process, or processes, herein fully described and made known, together with such modifications of said process, or processes, as are substantially the same in their nature and effects. M. Sorel.

Specification of a patent for a Process for extracting the colour from Dye Woods; granted to LAURENS KENT, *Dorset, Bennington county, Vermont, September 27th,* 1838.

To all whom it may concern: Be it known, that I, Laurens Kent, of Dorset, in the county of Bennington, and State of Vermont, have invented a new and improved mode of extracting the colour from dye woods, by steam, or distillation, rendering or reducing the same to a gum or powder; and I hereby declare that the following is a full and exact description.

The nature of my invention consists in extracting the colour from dye woods, reducing the same to a gum, or powder, in a pure state, and in greater quantity than can be produced in the common way of boiling. To enable others skilled in the art, to make and use my invention, I will proceed to describe the same.

I construct a steamer, or tub, sufficiently large to contain four or five hundred pounds of ground wood, said tub standing on its end; eight inches from the bottom I fix a fine strainer, the tub above the strainer is then filled and made perfectly tight; through the centre of the head I enter my steam pipe from the boiler or still, which is of brass or copper; the steam condenses in the wood, and leaches into the space below the strainer; strong liquor is thus drawn off and put again into the boiler, and the water or liquor run off again into the wood, as before, leaving the colouring substance in the boiler, which is taken out and dried. As the colour or gum of some dye woods cannot be exhausted perfectly with water, I sometimes make use of alcohol, and in that case I enter a worm below the strainer, seven inches from the bottom of the tub, to condense the alcoholic steam that comes through the wood.

What I claim as my invention, is the manner herein described, of extracting the colour from dye woods, by steam and distillation, reducing the same to a gum, or powder, in a pure state, separate from the wood, to be used in dyeing and staining.

LAURENS KENT.

Description of sundry machines used in the manufacture of Silk, as improved by Mr. GAMALIEL GAY; *said several improvements having been secured by letters patent of the United States.*

Mr. Gay has furnished us with cuts of his improved machinery, for the manufacturing of silk, with a request that a brief description of them may be inserted in the Journal, a request with which we most cheerfully comply, as the subject is one that has for some time past excited a very extended and intense interest; and the adaptation of our country to the production of the raw material, is no longer to be considered as problematical. It is the design of the Editor to give descriptions of any other machinery used, or proposed to be used, in this branch of business, and which may appear worthy of particular notice.

Fig. 1, in the accompanying engravings is a machine for unwinding silk from the cocoons, and winding it upon spools, or bobbins. The vessel *a*, is for containing the warm water in which the cocoons are immersed, and which is kept at a proper temperature by being placed over the furnace *b*. The silk passes from the cocoons over wire loops at *c*, *c*, and thence to wire loops, or eyes *d*, *d*, *d*, these latter being fixed to traversing bars, *e*, *e*, on either

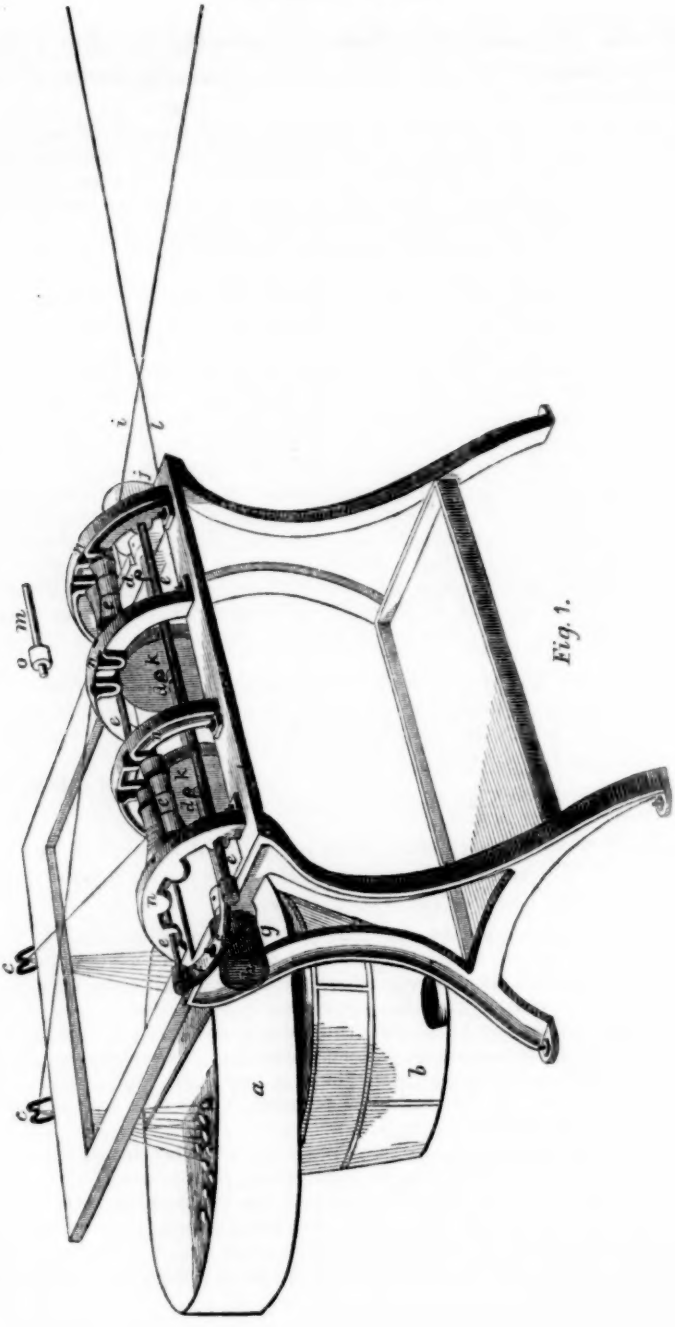


Fig. 1.

side of the machine; these bars are connected together by pieces of metal *f*, extending from one traversing bar to the other. To cause these bars to traverse there is an oblique groove *g*, in the hub *h*, into which a pin enters that projects down from the piece *f*. The hub *h*, is on a shaft which passes from end to end of the machine, and is made to revolve by means of a band *i*, *i*, on the whirl *j*; upon this shaft, also, there are wheels *k*, *k*, which give motion to the spools, or bobbins *e*, *e*. The spool is put upon a spindle *m*, the ends of which fall into grooves on the arches *n*, *n*, *n*, the collar *o*, rests upon the wheel *k*, the revolving of which causes the spool to revolve.

Fig. 2, is a machine for doubling and twisting the silk after it has been wound upon spools or bobbins; and fig. 3, is a top view of said machine. The bobbins *a*, *a*, *a*, are placed upon pins rising vertically from the top, *b*, *b*, of the machine; from two or more of these bobbins, the silk is carried round a roller, which is denominated a delivering roller; these rollers are shown at *c*, *c*, *c*, and one of them drawn larger, and separate from the machine at *d*; they are made of iron, and are turned with a hollow, or concave round the middle of them, and around this the silk is to have one or two turns, in its passage to the spindles. The gudgeons on the ends of these rollers fall into notches in the frame of the machine, and their periph-

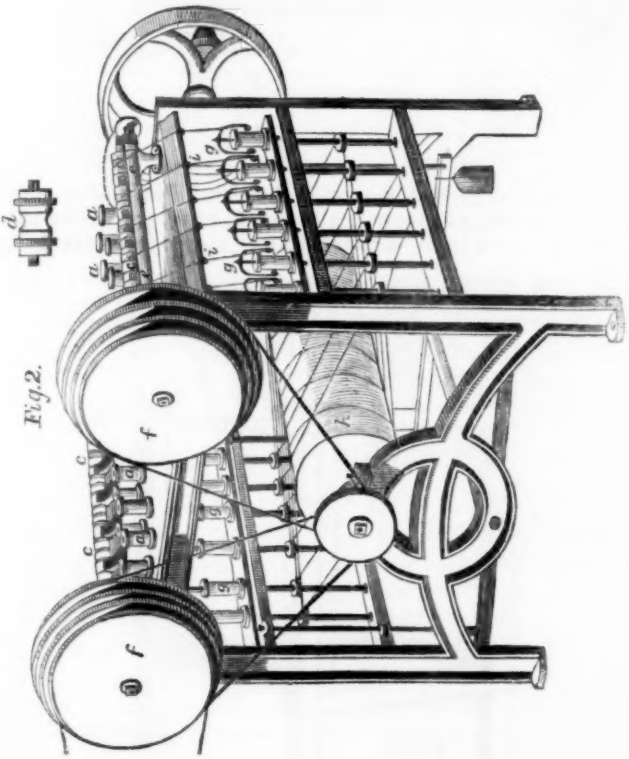


Fig. 2.

eries rest upon round shafts *e*, *e*, which are made to revolve by means of the whirls *f*, *f*. The dark lines on these rollers, represent bands of leather which surround them, and which come into contact with the shafts *e*, *e*, and afford the degree of adhesion and friction requisite to give them motion,

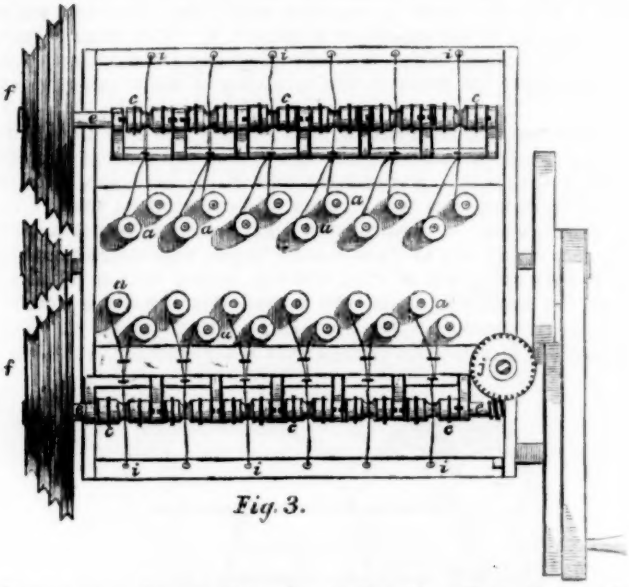


Fig. 3.

and to give a proper degree of tension to the silk. From these rollers the silk passes to the flyers and spools *g*, *g*, *g*, fig. 2, which are carried by bands from the drum *h*, in the usual manner; in its passage from the delivering

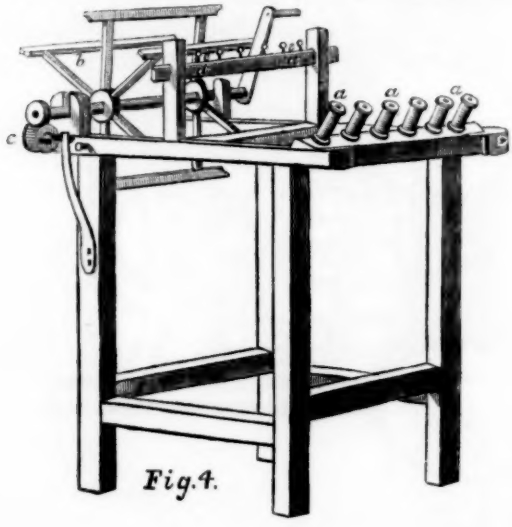


Fig. 4.

rollers to the spools, the thread passes through wire loops *i*, *i*, *i*. The traversing of the spools up and down is effected by a vane rail, operated on by the heart motion, as in numerous other machines, the toothed wheel *j*, gearing into an endless screw governing this motion.

Fig. 4, is a machine for winding the silk into skeins, after it has been doubled and twisted for sewing silk. The bobbins upon which the silk has been wound are placed upon pins at *a*, *a*, *a*; the reel *b*, is of the proper size for the skein, and attached to its shaft at *c*, there is the well known apparatus to give notice when a sufficient length has been reeled to form a skein. When this takes place, a shifting bar *d*, *d*, which carries the wire loops *e*, *e*, is slid along to a short distance, which will cause the next set of skeins to occupy another part of the reel.

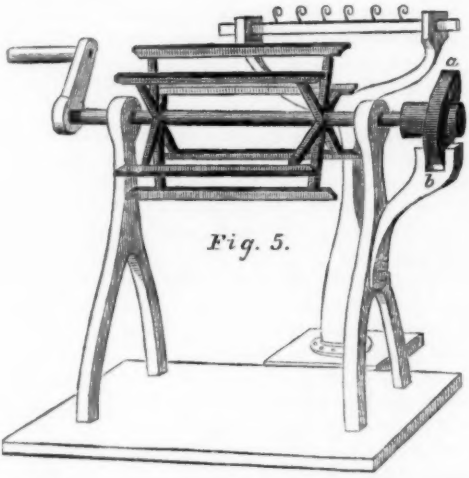


Fig. 5.

Fig. 5, is a reel having a traversing motion, which traversing motion is given by means of a wheel *a*, formed by cutting a cylinder obliquely to its axis at such an angle as will cause the reel to traverse to the extent desired. The periphery of the wheel *a*, is received within a notch on the guide piece *b*, the effect of which will be apparent.

Specifications of English Patents.

Specification of a patent, granted to WILLIAM DOLIER, *of Liverpool, for his invention of a certain durable surface or tablet for the purpose of receiving writings, drawings, or impressions of engravings or other devices capable of being printed, which surfaces may be applied for roads or pavements, and parts of which invention may also be used as the means of strengthening and beautifying glass.*—[Sealed 30th August, 1838.]

My invention of a certain durable surface or tablet, for the purpose of receiving writings, drawings, or impressions of engravings or other devices

capable of being printed, consists, firstly, in the application of a well known composition or material as a durable tablet or surface for receiving writings or drawings, and which may be removed at pleasure by moisture. This composition or material is common glass enamel, made in the ordinary manner from flint glass, borax, and arsenic, and which I roll out in thin plates of any required dimensions, exactly similar to manufacturing plate glass; and after it has been ground and polished, I remove the glazed surface by grinding with the finest emery powder, and then the tablet is ready for use. This permanent tablet will now be found capable of receiving the finest writing or drawing, and also beautifully adapted to receive paintings and impressions, exactly in the same manner as ornamenting china by painting or transfer.

This improved tablet will be an elegant appendage to various domestic purposes and furniture, and may be manufactured into sideboards, billiard tables, table tops, and all other similar ornamental purposes; and may have either a highly polished, or a dead, surface, and may be composed of any variety of colours by altering the ingredients of the enamel, which is well understood.

My second improvement in a durable surface, is in rendering the same perfectly pliable, and still rendering such surface durable. This is composed by a foundation of a sheet of linen, silk, cotton, or other cloth, linen being preferable, to be coated or covered upon one side with a mixture or composition, and treated as follows:—Spread upon the reverse side of the sheet of linen, one coat of a size or varnish, made by dissolving one pound of buffalo skin in one gallon of water over a slow fire, and let the other side, when dry, be rubbed with pumice stone, in order to remove all inequalities, and leave the surface perfectly smooth. This surface is now to be coated three times with a mixture of the purest white lead, called flake white, with boiled linseed oil and spirits of turpentine, in about the proportions of one pound of white lead to one quart of oil and half a pint of turpentine. After this has become perfectly dried, the flexible surface is ready for use, and is most suitable for printing, and particularly advantageous for receiving impressions of maps or charts for marine and general purposes, as being permanent and durable. The back or reverse side of this prepared cloth may be flocked with pulverized woollen cloth in the usual manner of flocking paper hangings, which will improve its appearance and make it more suitable for ornamental purposes. Gold, silver, or bronze surfaces may also be given to the cloth thus prepared, by giving it a coat of the buffalo size, and dusting the metallic powder over it.

Thirdly, these improvements are applicable to roads and pavements for bath-rooms and other similar situations, or tesselated pavements, where damp or wet is liable to get between the joints of the pavements, and form unhealthy and improper secretions; and consist in putting together squares of such enamelled surfaces as first above described, or common bath tiles in squares in different colours and devices, and cement or cover the joints with a light coating of glass enamel fused over the joints in order to render them perfectly secure; and in all situations where cleanliness and beauty are required, this will be found particularly useful.

A further application of this invention may be made by having engraved or printed maps, or other designs, made upon the under side of plates of glass, and vitrifying the glass to render the design permanent, and paving rooms with such plates or squares for the purposes of recreation; and also by inserting rails of glass, either in bars, rods, or plates set edgewise in

grooves or sleepers of wood or metal, making such rails either portable or permanent, and also intended as applicable to various amusements which may thus be pursued in gardens or other situations.

The fourth feature in my invention relates to the strengthening and beautifying glass, and consists in preparing sheets or plates of glass in the usual manner, and placing between two plates a metallic web of wire, wrought into any form or design that may be desired, and then partially fusing the glass so that the glass shall run between the meshes or interstices of the metallic design, and thus consolidate or embody the whole into one plate of glass, with the metallic design in the centre.

The metallic web or design may be formed of either plain net, or any other elegant scroll work or other design, and be composed of brass plated, or other metallic wire, and cast into any form or device which shall be required, and the glass fused around it, and rolled or pressed in the ordinary manner of manufacturing plate glass.

Another adaptation of these improvements is particularly applicable to ornamental windows and casements, where the glass is not required to surround the metal upon all sides. A suitable casting is to be prepared in brass, iron, or other metal, of the exact form of the window frame required; for instance, an ornamental Gothic window, and this casting is to be the framework of the window. The glass is then to be cast in its fluid state into the metallic framing, and may either be rolled of such a thickness that the metal frame shall be in the centre of the plate of glass, or it may be rolled down until the glass shall only fill the interstices of the metallic framing; and thus in either case, the whole of the panes or compartments, of an ornamental window may be made in an entire piece, and of any variety of form, strength, or beauty. The glass is afterwards to be annealed in the usual manner, and then submitted to a bath of cold linseed oil, which is to be caused gradually to boil, and after removing from the fire and allowed to cool, which will thus form a second annealing, and also regulate the expansion and contraction of the metals. The glass is to be ground up and polished in the usual manner, and may either be made bright for windows, or rendered opaque to be employed for all useful and ornamental purposes for furniture, to be used instead of the finest marbles, and with equal beauty and effect.

This combination of metals with glass, for the purpose of increasing its strength, will be of material importance for "dead lights" for all marine purposes, and also forming perpetual window blinds; and it will be evident that great strength may thus be given to glass for windows and such similar purposes by either of the processes above described.

Lond. Jour. of Arts & Sci.

Specification of a patent granted to Eugene Richard Ladislas De Breza, *of Paris, in the kingdom of France, now of the county of Middlesex, for his invention of a chemical combination or compound for rendering cloth, wood, paper, and other substances indestructible by fire, and also preserving them from the ravages of insects.*—[Sealed 20th February, 1838.]

The chemical compound alluded to in the title of this patent, consists of the following materials, and is mixed in the following proportions:—For linens and unbleached goods, take two pints and a half of water, and after raising the temperature to 190 degrees of Fahrenheit's thermometer, add one

ounce of alum, with one ounce and a half of sulphate of ammonia, half an ounce of boracic acid, one drachm of glue, the best and finest that can be procured, and add to the whole one drachm of starch dissolved in a small quantity of water.

Before the starch is added, the temperature of the mixture should be raised to at least 212 degrees of Fahrenheit; care should be taken that the several ingredients are introduced in the order above mentioned, and also that each one is dissolved in the water before the next is added. The mixture being thus prepared, the goods to be preserved are operated upon in any suitable manner; for instance, plain unbleached goods may be immersed in the compound, and be allowed to absorb as much as possible, after which they must be pressed or wrung hard, in order to get rid of the redundant liquor; they are then dried in any convenient manner. Printed goods, when the colours are fast, may be treated in the same manner; but when the colours are not fast, the mixture should be applied with a sponge, care being taken that they are not wetted too much, otherwise the colours may perhaps run.

When timber is to be operated on, it is to be put into tanks and covered over with the mixture, which is raised to a temperature of at least 160 degrees.

For preserving paper or pasteboard, the mixture may be put into the vat containing the pulp from which the paper or pasteboard is to be made, or the paper may be immersed in the mixture after it is manufactured.

When the invention is to be applied to theatrical scenery already in use, sheets of paper prepared in the manner described, should be pasted at the reverse side; but for new scenery the canvas may be steeped in the solution.

It is observed that it is not to be supposed the said composition will render the various articles indestructible by fire, but that it merely prevents them from bursting into flame, and by that means communicating the fire from one thing to another.

In conclusion the patentee states that he is aware that some of the ingredients above mentioned have been used for similar purposes to those which his invention is intended to be applied; but what he claims as his invention, is the making a composition consisting of alum, sulphate of ammonia, boracic acid, glue, and starch, mixed in the above order and proportions, to be applied to various articles; and which composition will render them indestructible by fire, and protect them from the ravages of insects.

Idem.

Specification of a patent granted to John Isaac Hawkins, *of the county of Middlesex, for certain improved instruments for facilitating the cure of disease, by administering galvanic influence into the human body; being a communication from a foreigner residing abroad.*—[Sealed 13th March, 1834.]

The invention now under our notice, consists in administering galvanic influence in a mild and gentle manner, in place of the shocks given by the galvanic apparatus at present in use. The patentee has described several ways of administering galvanism under different circumstances for the cure of various diseases, and the apparatus employed, although differing in shape

to suit circumstances, is, in principle, essentially the same; we shall, therefore, confine ourselves to the explanation of one or two descriptions. For the cure of toothache, the patentee has an apparatus consisting of two metal plates, one of silver, the other of zinc, the edges of the two being soldered together. The plates must be of a shape and size suitable to go inside the mouth, and be placed upon the gums.

In some diseases the outer skin may be in such a torpid state, as to withstand the gentle effects of the apparatus; in such cases an incision should be made, and the galvanism conveyed direct to the inner skin, by which it will be communicated to the nerves; and the whole system, by this means, be roused from its torpidity into a wholesome and natural state of exertion.

Idem.

Notice of a patent granted to ANTHONY THEOPHILUS MERRY, *of Birmingham, for his invention of the application of certain white metal plated to certain manufactures, to which it has not hitherto been applied.*—[Sealed 3th March, 1836.]

This invention is merely the application of German silver, or any other alloy of nickel, to the manufacture of silver plated goods, so that when the real silver with which the article is plated shall have partially worn off, the edges or worn parts will still present a bright and silvery appearance. As the method employed in carrying the invention into effect is very similar to that now in general use in plating goods, it will not be necessary for us to describe it, especially as the patentee does not claim it, but confines his invention to the introduction of German silver, or such other white metal in the manufacture of plated goods.

Idem.

Notice of a patent granted to JAMES LUTTON, *of the county of Middlesex, for his invention of certain improvements in castors for furniture.*—[Sealed 25th November, 1834.]

The improvements set forth in the specification of this patent consist in adding a strengthening arm to the horn or bracket of the roller, in order that it may be better able to sustain heavy weights.

The invention, which is very simple, will be perfectly understood by referring to the annexed figure, which represents a side elevation of a castor: a flange or band *a*, forms the upper rim of the castor, as in the ordinary construction; but in this it will be seen that it is made of considerable strength, in order to resist the upward pressure of a collar *b*, to which is attached an arm *c*; and the lower end of this arm terminates in the horn or bracket of the roller.

It will be seen that this construction of castor must possess very great strength, and will consequently be capable of bearing very heavy weights.

Idem.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the relative Strength and other mechanical Properties of Cast Iron obtained by Hot and Cold Blast. By Eaton Hodgkinson, Esq.

[With a Plate.]

From the great abundance of the ores which produce iron; from the fortunate circumstance of these ores being frequently found in the neighbourhood of coal and limestone, by which they are reduced to the metallic state; from the great strength of the metal, and the facility with which it can be moulded into any form required—its uses in the arts have become very extensive. Every discovery, therefore, tending to facilitate its production, or to improve its quality, must always be regarded with great interest, whilst distrust and suspicion are likely to be felt respecting any process by which that quality may be supposed to be impaired.

The recent and very general introduction of a heated blast into the smelting furnaces has consequently, as might be expected, given rise to much discussion, and at the same time to great difference of opinion. Iron masters in one part of the country had come to a conclusion that the new process greatly deteriorated the quality of the iron produced, and they rejected it accordingly. Gentlemen from other neighbourhoods, on the contrary, maintained that no deterioration of the metal resulted from the process, which was admitted by all to diminish the expense of its production.

These very different conclusions, drawn by persons largely connected with the manufacture of cast iron, caused the honour of an application from the British Association for the Advancement of Science, at its meeting held at Dublin, to my friend Mr. Fairbairn and myself, requesting us to make a series of experiments tending towards the determination of this matter.

We intended to commence the inquiry immediately, but there was found to be great difficulty in obtaining irons suitable for the purpose; a matter which will be adverted to in Mr. Fairbairn's report, where a description of the irons used will be given.

In the prosecution of this research it was conceived desirable to subject the metals operated upon to more than one species of strain, in order to elicit their peculiar properties; and accordingly they were generally broken in the following three modes:—

1st. By tension, or tearing the metals asunder in the direction of their length.

2nd. By compression, or crushing specimens of different lengths, and various forms and sizes of base.

3rd. By a transverse strain, and this under different forms of section.

In this last mode of fracture some bars have been broken under various temperatures, and others have been loaded for a very long time with weights, nearly as large as would have broken them at once, and they are still bearing the loads.

The experiments on the transverse strain (excepting those on the Carron iron, No, 2, the Devon, and the Buffery, of which I read an account at Bristol) were made by Mr. Fairbairn, who undertook also the experiments on the effects of temperature and time. I was desirous that he should try the

effect of time upon loaded bars, being convinced that it would do little or nothing to destroy their power of bearing a dead weight; having arrived at his conclusion from experiments made in a different way upon malleable iron. As I was present at many of Mr. Fairbairn's experiments, I may mention the great care and ability with which they were made; they will form the subject of the next paper.

The experiments on the tensile and compressive forces of the metals, and those on the transverse strain read at Bristol, were made by myself and are given below.

Tensile strength of Hot and Cold Blast Cast Iron.—To determine the direct tensile strength of the different kinds of cast iron made use of in these experiments, a model was made of the same form as that I had previously used in some experiments on cast iron, of which a notice was given in the Cambridge volume of the Association. The castings from this model were very strong at the ends, in order that they might be perfectly rigid there, and had their *transverse* section for about a foot in the middle of the form annexed.

This part, which was weaker than the ends, was intended to be torn asunder by a force acting perpendicularly through its centre. The ends of the castings had eyes made through them, with a part more prominent than the rest in the middle of the casting where the eye passed through. The intention of this was that bolts passing through the eyes, and having shackles attached to them by which to tear the casting asunder, would rest upon this prominent part in the middle, and therefore upon a point passing in a direct line through the axis of the casting.

Several of the castings were torn asunder upon the machine for testing iron cables belonging to the Corporation of Liverpool. Others were made in the same manner but of smaller transverse area; these were broken by means of Mr. Fairbairn's lever, which was adapted so as to be well suited for the purpose.

The form of casting here used was chosen to obviate the theoretical objections made by Tredgold and others against the conclusions of former experiments.

The results are in the following table:

Results of Experiments on the Tensile Force of Cast Iron.

Description of Iron.	Area of section in inches.	Breaking weight in lbs.	Strength per square inch of section.	Mean in lbs. per square inch.
Carron Iron, No. 2, Hot Blast,	4.031	56000	13892	Tons. cwts
Do. do. do.	1.7236	22395	12993	13505=6 0½
Do. do. do.	1.7037	23219	13629	
Carron Iron, No. 2, Cold Blast,	1.7091	28667	16772	16683=7 9
Do. do. do.	1.6331	27099	16594	
Carron Iron, No. 3, Hot Blast,	1.7023	28667	16840	17755=7 18½
Do. do. do.	1.6613	31019	18671	
Carron Iron, No. 3, Cold Blast,	1.6232	22699	13984	14200=6 7
Do. do. do.	1.6677	24043	14417	
Devon (Scotland) Iron, No. 3, Hot Blast,	4.269	93520	21907	21907=9 15½
Buffery Iron, No. 1, Hot Blast,	3.835	51520	13434	13434=6 0
Do. do. Cold Blast,	4.104	71680	17466	17466=7 16
Coed-Talon (N. Wales) Iron, No. 2, Hot Blast	1.586	25818	16279	16676=7 9
Do. do. do.	1. 45	28086	17074	
Do. do. Cold Blast,	1.535	30102	19610	18855=8 8
Do. do. do.	1.568	28380	18100	

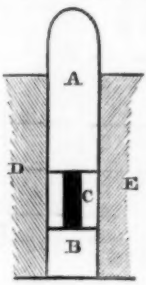
Compression, or the power to resist a crushing force.—In these experiments I shall confine myself to the resistance of short specimens; crushing, with few exceptions, only such as will break without bending. And if I should appear to pursue this and some other matters beyond the strict limits of the inquiry respecting the strength of hot and cold blast iron, I trust it will be excused, as my wish is to obtain some fixed principles where we have nothing but doubt and uncertainty.

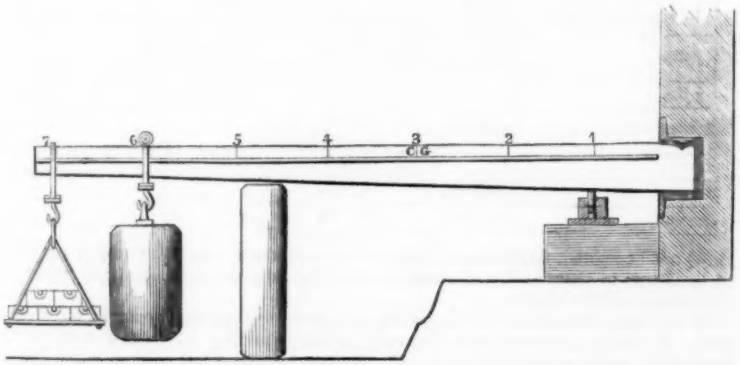
The tensile strength of cast iron is still a matter of dispute: the few direct experiments by Mr. Rennie and Captain Brown give from 7 to 9 tons per inch, results not widely differing from those above; they are noticed with some suspicion by Mr. Tredgold (Essay on strength of Cast Iron, pages 91 and 92), who concludes from reasoning on the transverse strength of cast iron, according to the theory which he had adopted, that the direct tensile strength must be 20 tons or more. Mr. Barlow too, whose reasoning has better foundation than Tredgold's concludes, whilst he gives these gentlemen's results, that the strength must be upwards of 10 tons per square inch, (Treatise on the Strength of Timber and other Materials, art. 123). I am not aware of any objection which can be brought against the tensile results given above, except some slight error which Mr. Barlow conceived (in his earlier work on the Strength of Timber, &c.) might arise from the use of testing machines, and that, in this case, would affect but four of the experiments, all the rest were made upon Mr. Fairbairn's lever. I hope to explain the cause of this difference of opinion among our ablest inquirers at a future meeting.

The resistance of materials to a crushing strain is equally a matter of doubt. Rondelet found *(Traité de l' Art de bâtir)* that cubes of malleable iron, and

prisms of various kinds of stone, were crushed with forces which were directly as the area, whilst from Mr. Rennie's experiment, both upon cast iron and wood, it would appear that the resistance increases, particularly in the latter, in a much higher ratio than the area, (Mr. Barlow's Treatise, Art. 112.,) I have endeavoured, by repeating with considerable variations the ingenious experiments of Mr. Rennie, to arrive at some definite conclusions.

In order to effect this, it was thought best to crush the object between two flat surfaces, taking care that these were kept perfectly parallel, and that the ends of the prism to be crushed were turned parallel and at right angles to their axis, so that when the specimen was placed between the crushing surfaces its ends might be completely bedded upon them. For this purpose a hole $1\frac{1}{4}$ inch diameter was drilled through a block of cast iron about 5 or 6 inches square, and two steel bolts were made which just filled this hole, but passed easily through it; the shortest of these bolts was about $1\frac{1}{4}$ inch long, and the other about 5 inches; the ends of these bolts were hardened, having previously been turned quite flat and perpendicular to their axis, except one end of the larger bolt which was rounded. The specimen was crushed between the flat ends of these bolts, which were kept parallel by the block of iron in which they were inserted. See fig. where A and B represent the bolts, with the prism C between them, and D E the block of iron. During the experiment the block and bolt B rested upon a flat surface of iron, and the rounded end of the bolt A was pressed upon by the lever. There was another hole drilled through the block at right angles to that previously described; this was done in order that the specimen might be examined during the experiment, and previous to it, to see that it was properly bedded.





The accompanying sketch will show more clearly the mode of performing the experiment, in which the lever was always kept as nearly horizontal as possible. Other apparatus, not here shown, was used to lift up or lower the lever during the experiments.

The results are given in the following tables:

Tabulated results of experiments made to ascertain the weights necessary to crush given cylinders, &c., of Cast Iron, of the quality No. 2, from the Carron Iron Works. The specimens in the first three columns of results, both in the hot and cold blast irons, were from cylinders cast for the purpose and turned to the right size; the $\frac{1}{8}$ inch from those of about $\frac{3}{4}$ inch, &c.

TABLE 1st.—HOT BLAST IRON.

Height of Specimens.	Cylinder, $\frac{1}{4}$ inch diameter; Crushing weight.	Cylinder, $\frac{1}{8}$ inch diameter; Crushing weight.	Cylinder, $\frac{1}{2}$ inch diameter; Crushing weight.	Cylinder, .64 inch diameter; Crushing weight.	Right prism, base a square $\frac{1}{4}$ inch the side, cut out of an inch square bar; Crushing weight.	Right prism, base a rectangle 1.00×.26 inch, cut out of the middle of a bar $1\frac{1}{4}$ inch square.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
$\frac{1}{8}$ in.	8737 } (*a*) 8145 }	18882(*b*)	30461(*c*)			
$\frac{1}{4}$ do.	6658 } Mean 7103 } 6880(*d*)	14850 } Mean 17538 } 16194	25169(*e*)			
$\frac{3}{8}$ do.	6658 } Mean 6468 } 6563	13282	25169			
$\frac{1}{2}$ do.	6405 } Mean 6405 } 6405	13282	23797 24189 } Mean 23993 } 23993		25365 } Mean 26149 } 25757	27788
$\frac{5}{8}$ do.	6341 } Mean 6278 } 6309	13730		38671		
$\frac{3}{4}$ do.		15522 } Mean 15662 } 15592	21522	35888	23797	
$\frac{7}{8}$ do.				35888		
1 do.		15564	21053 } Mean 21053 } 21053			24764
$1\frac{1}{4}$ do.			23869			
$1\frac{1}{2}$ do.		14584	23053			
2 do.		13800	21828			

(*a*) not crumbled, flattened; (*b*) flattened and cracked round the edges; (*c*) reduced in thickness to about half, and cracked round the edges; (*d*) crushed; (*e*) reduced and cracked round the edges.

In all cases where the crushing weight is given without any remark, we may conceive the fracture to have taken place by a wedge sliding off from one of the ends, having the whole end for its base. The rectangles in the last column broke differently, a wedge nearly equilateral formed at the top and bottom which split the sides; the face of the rectangles being divided diagonally.

TABLE 2nd.—COLD BLAST.

Height of Specimens.	Cylinders ¼ inch diameter. Crushing weight.	Cylinders ⅜ inch diameter. Crushing weight.	Cylinders ½ inch diameter. Crushing weight.	Right prisms, base an equilateral Triangle, circumscribing a ½ in. cylinder, its sides being .866 in. Crushing weight.	Right prisms, base a square, ½ inch the side. Crushing weight.	Right prisms, base a rectangle 1.00 × .243 inch.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
¼ in.	6738, 6774 } Mean 6756	17034(*a*)	28798(*b*)			
⅜ do.		14190	27230(*c*), 26838 } Mean 27034			
½ do.	6197, 6197 } Mean 6197	13994(*e*)	24388, 24682 } Mean 24535	35548(*d*)	27042, 24780, *25270 } Mean 25697	26587
⅝ do.		14582				
¾ do.	5908, 6053 } Mean 5980	13994	24486, 24388 } Mean 24437	33448	24780, *23996 } Mean 24388	26587
1 do.	5764, 5836(*g*) } Mean 5798	14190	24780, 24584 } Mean 24682	31348(*f*)	24296, *23604 } Mean 23950	25538
1¼ do.		14190	24486			
1½ do.		13702(*h*)	23604(*i*), 23702 } Mean 23652			

(*a*.) With this weight the specimen was flattened in the middle and crushed round the edges.

(*b*.) The specimen was reduced in thickness to 1-10 of an inch, and broken round the edges.

(*c*.) Crushed except the centre.

(*d*.) Fracture, a pyramid, splitting the three sides, one base whole, and the vertex of this base shown in the other.

(*e*.) Bulged out in the middle before breaking.

(*f*.) Fracture by the ends forming the bases of pyramids meeting in the centre and throwing out the corners. See drawing.

(*g*.) Specimen slightly bent; wedge .46 inch long.

(*h*.) Pillar bent a little, cracked across the middle; no alteration previous to fracture.

(*i*.) Bent a little with about a ton less than what broke it.

The specimens in the first column were turned out of a bolt ⅝ inch diameter. All the specimens in the last three columns were out of the centre of a bar 1¼ inch square, except those marked *, which were from the middle of an inch bar. The wedges broken off from three of the longest cylinders ⅜ inch diameter measured in length .56, .50, .52 inch respectively. Two wedges from the ½ inch cylinders, 1 inch high, measured .68 and .65 inch in length.

By comparing the results in the two preceding tables, it will be seen that, where the length is not more than about three times the diameter, the strength for a given base is pretty nearly the same, as has been shown by Mr. Rennie and others. In that case, the prism, in cast iron at least, either does not bend before fracture, or bends very slightly, and therefore the fracture takes place by the two ends of the specimen forming cones or pyramids, which

split the sides and throw them out; or, as is more generally the case in cylinders, by a wedge sliding off, starting at one of the ends, and having the whole end for its base, as has been before mentioned; this wedge being at an angle dependent upon the nature of the material. In cast iron this angle is, as will be seen further on, such that the height is somewhat less than $\frac{3}{2}$ of the diameter; if the height of the specimen is less than the length of the wedge, the resistance is somewhat increased, and if the height be greater than from three to four times the diameter, the resistance, on account of the flexure of the specimen, will be decreased. In estimating the strength of the iron from the above table, I shall mostly confine myself to such specimens as vary from about the length of the wedge to twice its length, avoiding such results as are reduced by flexure. Taking then the results from the cylinders and prisms of different dimensions of base, giving the means, with the number of experiments from which they were taken, we have the following abstracts:

FROM TABLE I.—HOT BLAST.

Diameter of cylinder.	Number of experiments.	Mean crushing weight	Mean crushing weight per sq. inch.	General mean per square inch.
		lbs.	lbs.	
$\frac{1}{4}$	3	6,426	130,909	121,685 lbs.= 54 tons 6½ cwt.
$\frac{3}{8}$	4	14,542	131,665	
$\frac{1}{2}$	5	22,110	112,605	
$\frac{16}{25} = .64$	1	35,888	111,560	
Prism, base .50 inch square.	3	25,104	100,416	100,738 lbs.= 44 tons 19⅓ cwt.
do. base 1.00 × .26	2	26,276	101,062	

FROM TABLE II.—COLD BLAST.

Diameter of cylinder in parts of an inch.	Number of experiments.	Mean crushing weight.	Mean crushing weight per sq. inch.	General mean per inch
		lbs.	lbs.	
$\frac{1}{4}$	2	6,088	124,023	125,403 lbs.=55 tons 19½ cwt.
$\frac{3}{8}$	4	14,190	128,478	
$\frac{1}{2}$	7	24,290	123,708	
Equilateral triangle side .866.	2	32,398	99,769	100,631 lbs.=44 tons 18½ cwt.
Squares, ½ inch the side.	2	24,538	98,152	
Rectangles, base 1.00 × .243.	3	26,237	107,971	
Cylinders .45 inch diameter and .75 high (not in table.)	2	15,369	96,634	

The prisms, whose bases were triangles, squares, rectangles, and the cylinders last mentioned, were all cut out of the centre of a bar 1¼ inch square.

It will be noticed that the cylinders in both the tables give much higher

results per square inch than we have just found from the specimens cut out of the $1\frac{1}{4}$ inch bar. This the writer is inclined to attribute to no other cause but that they were mostly turned out of small cylinders cast for the purpose, which caused them to be harder than those from the middle of a larger mass.

We will defer speaking of such comparative results as affect the general question of hot and cold blast iron, till all the evidence is obtained which the present paper will afford; drawing, however, as we proceed, such other conclusions as seem to be made out from the experiments.

Taking the mean crushing weight per square inch, as just obtained in the abstracts from the different cylinders in the 1st and 2nd tables, and retaining only the three first figures, we have

From 1st table, diameter $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{16}{25}$	Strength per inch.	131,	132, 113, 112.
From 2nd do. $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$		124,	128, 124.

The strengths per square inch in each of these lines approach to an equality, particularly in the latter, where the areas of section vary as 1:4; and the strength per inch is in both cases represented by 124. In the former line the cylinders of $\frac{1}{4}$ and $\frac{16}{25}$ inch diameter give strengths varying as 131 to 112 per square inch. The areas here vary nearly as 1:6.5, and the falling off in strength is about one-sixth. This small diminution in the power of the larger cylinders to resist crushing, may be accounted for from those having been cut out of a larger body of metal than the small ones; a matter which we have seen greatly reduces the strength.

Admitting, then, that the strength per square inch in each of the preceding cases would have been the same if the iron had always been of equal hardness, we must conclude that "the resistance of short cylinders of cast iron to a crushing force is directly as the area."*

If we refer to the abstract from tables 1 and 2 for the mean strengths per square inch, as given by the equilateral triangle, the square, the rectangle, and the cylinder, we shall find them

In the latter,	99,769.	98,152.	107,971.	96,364;
In the former,		100,416.	101,062.	

The strength, 107,971 and 101,062, as given by the prisms whose base is a rectangle, is the greatest;† and this may be accounted for from their superior breadth to that of the other specimens, and consequently, from their having in them more of the outside and harder part of the bar, out of which they were cut, than the others. In the other forms the difference of

* Conceiving it desirable that this matter should be left without a doubt, and as Mr. Fairbairn had some very good teakwood which had been many years in store, 12 cylinders were turned whose diameters were $\frac{1}{2}$ inch, 1 inch, and 2 inches, 4 of each; the latter 8 out of the same piece of wood; the height in each case was double the diameter; the strengths were as below.

Cylinders $\frac{1}{2}$ inch dia.		Cylinders 1 inch dia.		Cylinders 2 inches dia.	
2335		10507		38909	
2543	Mean	9499	Mean	39721	Mean
2543	2439	10507	10171	41294	40304
2335		10171		41294	

These quantities, taking the means, are nearly as 25,100 and 400, which is the ratio of the areas, and therefore the strength is nearly as the area, though this varies as 4 and 16 to 1.

† Rondelet (*Traité de l'Art de bâtir*, book ix, page 150) found that prisms of stone, whose base was a rectangle, as above, bore somewhat *less* than those with square bases of the same area.

strength is but little; and therefore we may perhaps admit that "difference of form of section has no influence upon the power of a short prism to bear a crushing force."

Mode of Fracture. *See Plate* 1.—When a rigid body is broken by a crushing force, which is prevented from acting after it has effected a rupture, it will be found not to be crumbled or reduced to a shapeless mass, but to be divided according to mathematical laws, and sometimes into very interesting forms of fracture. The accompanying plate will show how the fracture was effected in a variety of cases, and that these were all subject to one pervading law. The figures in the plate are of the same size as the specimens. Fig. 1 represents a cylinder before it was crushed; fig. 2 represents a wedge broken off from the same cylinder, the point of the wedge being flattened by the crushing apparatus after the fracture. There is a small crack in this wedge indicating a disposition to slide off in another direction, or rather to form a double wedge, nearly equilateral, having the diameter of the end of the cylinder for its base, and its height about half that of the former. The operation of this double wedge would be to split the cylinder and throw out its two sides. Figs. 3 and 4 represent another cylinder before and after crushing; in fig. 4, a double wedge formed at each end threw out the opposite sides. Figs. 5 and 6 represent a cylinder before and after crushing; in the latter, as in fig. 4, the ends of the figure have formed the bases of imperfectly formed cones, whose tendency has been to separate the sides. Fig. 7 is intended to represent one of these cones, the vertex of which is a sharp edge or point. Fig. 8 represents another cylinder of rather soft iron; the pressure was removed in the commencement of the fracture, and the circumference was found to be surrounded with parallel cracks both ways; the angle of these cracks with the base being that of the usual inclination of the wedge. Fig. 9 represents the appearance of a very short cylinder after fracture; the vertex of the cone, formed upon the end not shown, has split the end here represented, leaving a part in the middle unbroken; the opposite end is sound for a much greater central area than this, but its edges are a little broken.

Fig. 10 represents a rectangle;* and fig. 11 its appearance after fracture. One end of the specimen has been formed into a pyramid *a*, sharp pointed at *d*, which has split the opposite base and thrown off the end *b*, and the part *c* very nearly. The sides and angular piece at the end are lost.

Fig. 12 represents a short rectangle before crushing; figs. 13, 14, 15, the different appearance of specimens of the same size after fracture. In fig. 14 the fracture has been caused by a sliding off in the way of the diagonal; in fig. 15 the specimen slided off in the direction *b c*, as before, and was cracked through its whole length in the direction *a d*; in fig. 13, the top of the specimen formed the base of a wedge which had split the bottom, and the bottom itself had formed the base of a wedge. Fig. 16 represents a rectangle of the same base as the preceding, but of double the height. Figs. 17, 18, 19, 20, represent its appearances as shown by different specimens after fracture. Fig. 20, in which the parts are separated, shows a wedge *a c d*, which has for its base the bottom of the prism; this wedge has, commencing its vertex *c*, a sharp line *c d*, $\frac{1}{4}$ inch long; and by the operation of its sides, the wedge has removed the parts *e* and *f*, and separated the sides *g* and *h*, which before jointed together at the top and formed part of the upper side of the prism. The part *a b*, adhering to the lower part of

* The prism is, in this and many other places, designated by the form of its base.

the wedge, and which had formed part of the side of the prism, was nearly separated by the action of another wedge formed by the lower end of the part *g*, which formed a wedge not represented by the figure, but whose vertex formed a sharp line about .43 inch long in the direction *i k*. This wedge occupied the space between *b* and *c d*, and its tendency was to split off from the principal wedge the only remaining portion *a b*.

Fig. 21 represents a prism of the form of an equilateral triangle, and fig. 22 is its appearance after fracture. The tendency is here, as before, for opposite wedges to be formed, which split off the angles and separate the sides. Figs. 23, 24, 25, give direct representations of the three sides.

Angle of Wedge.—We have seen that when bodies are subjected to a crushing force, their fracture, if they do not break by bending, is caused by the operation of a cone or wedge, which seems, under various circumstances, to slide off at nearly a constant angle. If a prismatic body, as for instance, a short cylinder, be subjected to a crushing force, there seems no reason why fracture should take place one way more than another; there is usually too in soft irons a bulging out in every direction round the cylinder, which shows that it is equally strained all round: a matter which is otherwise exemplified in fig. 8. If then the cylinder be longer than the wedge, or than the two cones which are always in operation at the ends during crushing, it is evident that the angle of the wedge and cones, which is the same, will depend upon the nature of the material, and the cones must be isosceles. Cylinders longer than the wedge usually slide off in one direction without showing the cones, but some examples in other forms have been obtained; as for instance, in the fracture of a rectangular specimen whose base was 1.00×.26, and its height .50 inch (Table I,) the rupture took place by wedges, which appeared to be isosceles, being formed at the top and bottom of the ends of the specimen, and dividing the sides in the middle, as in the annexed figure.

In cases however where the height of the specimen was not equal to that of the two opposing or double wedges, then these cones and wedges could not be isosceles after fracture commenced. It is shown by several of the figures (figs. 4, 6, 11, 13, 20, &c.) how fracture takes place, and that in such cases the wedges do not meet directly and crush their opponents, but have sharp points and slip past each other to effect the destruction of the piece of which they are formed. It is evident therefore that the angles, which the sides of these wedges make with their base, cannot in this case be equal; this is shown by the rectangles one inch high, and it was found to exist in a higher degree in the fracture of those of half the height. In these the angle with the base was further reduced, through an almost necessary tendency of the specimen to divide itself in the diagonal; though the angle there was less, on account of the compression of the prism, than the natural angle in this material. The angle of the wedge as obtained from different specimens is as follows:

Cylinders.

Carron Iron, No. 2, 54° 15′, 54° 15′, 52° 10′, 59°, 56° 15′	Mean	55° 11′
Buffery Iron, No. 1, 58°, 54°, 56°, 58°, 56°, 62°, 56°	Do.	57° 8′
Coed-Talon, No. 2, 55°, 56°, 56°, 53½°, 53°, 49°	Do.	53° 40′
Mean angles from cones 56½°, 54½°, 57½°	Do.	56° 10′
Mean from the whole, being 21 cylinders of various lengths,		55° 32′

Rectangular prisms 1 inch high, Carron Iron, No. 3, angles made by the sides of the double wedge, with the base.

Cold Blast	54°			
	58			
Hot Blast	58½	55½°	53°	Mean 56° 48′
	57	60		
	54½°			
	60			

Rectangular prisms ½ inch high, Carron Iron, 48°, 51°, 52°, 54°, 57°, 52°, Mean 52° 40′

Mean angle from the above rectangular prisms 54° 41′

Prisms, Base .50 × .50 inch.

Carron Iron, No. 2 53°, 54° Mean 53° 30′

From the preceding examination of the angles obtained from specimens of different forms and lengths, it appears that amidst great anomalies, there is, taking the *mean* results, a considerable approach to equality, as is more particularly shown from the angles of the cylinders and rectangular prisms; and this approach would doubtless have been greater and the anomalies less if the specimens had always been longer than the wedge. The defect in the angle from this cause is evident in the shorter rectangular prisms, and has been alluded to before.

We may assume therefore, without assignable error, that in the crushing of short cast iron prisms of various forms, longer than the wedge, the angle of fracture will be the same. This simple assumption, if admitted, would prove at once, not only in this material but in others, which break in the same manner, the proportionality of the crushing force in different forms to the area; since the area of fracture would always be equal to the direct transverse area multiplied by a constant quantity dependent upon the material.

The preceding experiments on crushing have been confined to one sort of iron, the Carron No. 2, hot and cold blast. The results from other irons are given in the following table:—

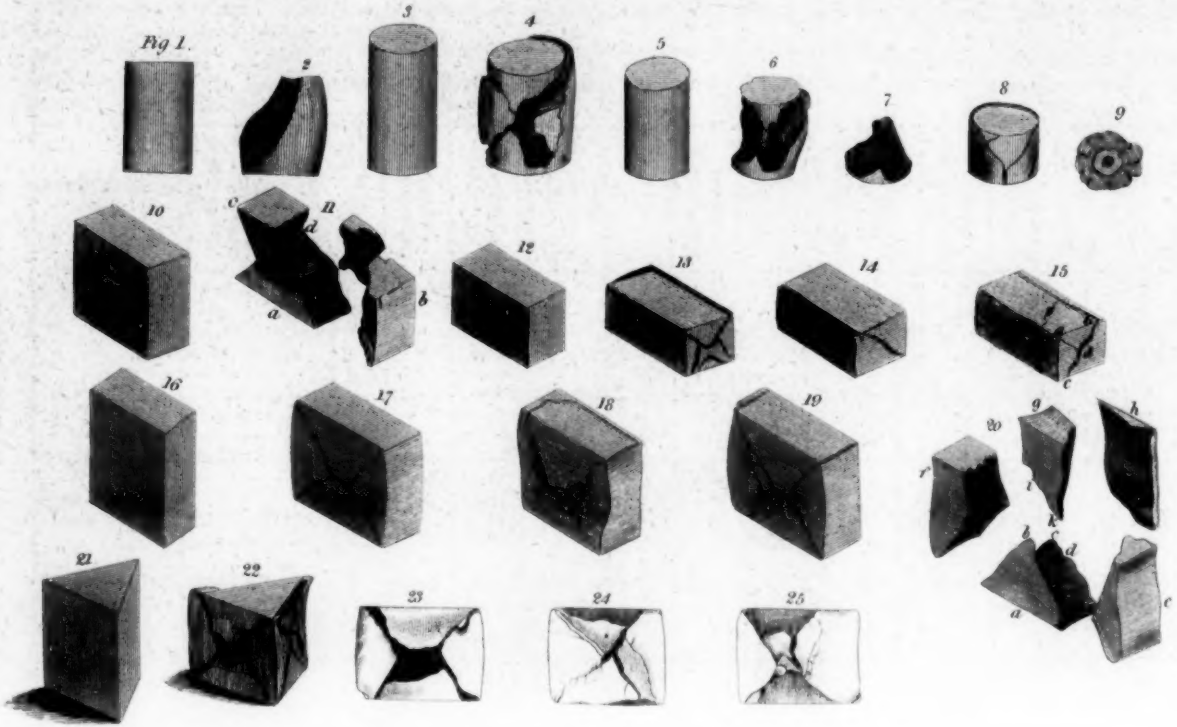


Fig 1.
2
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c
d
a
b
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COMPRESSION.—TABLE, No. III.

Result of Experiments to ascertain the forces necessary to crush short cylinders, &c. of cast iron, from various parts of the United Kingdom. All the cylinders were turned out of bars cast 1 inch square, and the rectangular prisms were cut out of the castings broken in the experiments on tension.

Devon (Scotch) Iron, Hot Blast. No. 3.			Buffery (near Birmingham) Iron, No 1.				Coed-Talon (Welsh) Iron, No. 2.				Carron (Scotch) Iron, No. 2. Right Prisms, area of base $\frac{3}{4}\times\frac{1}{3}=\frac{1}{4}$ inch.				Carron (Scotch) Iron, No 3. Right Prisms, area of base $\frac{3}{4}\times\frac{1}{3}=\frac{1}{4}$ inch.			
Height of specimen.	Cylinder .505 Diameter inch.	Cylinder .380 Diameter inch.		Height of specimens.	Crushing weight in lbs.	Mean crushing weight per square inch in lbs.		Height of specimens.	Crushing weight in lbs.	Mean crushing weight in lbs. per square inch.		Height of specimens.	Crushing weight in lbs.	Mean crushing weight in lbs. per square inch.		Height of specimens.	Crushing weight in lbs.	Mean crushing weight in lbs. per square inch.
	Crushing weight in lbs.	Crushing weight in lbs.	Hot Blast. Diameter of cylinder .505 inch.	½ inch.	17,823		Hot Blast. Diameter of cylinder .6075 inch.	½ inch.	25,541		Hot Blast.	.50	27,541		Hot Blast.	.50	34,037	
				1 "	17,039			1 "	24,278			1.00	26,729			.75	33,631	
				1½ "	17,431			1½ "	23,228							1.00	32,413	
				2 "	16,927			2 "	22,878									
¾ inch.	31,138	15,323		Mean	17,305	86,397 = Ton Cwt 38 11¼		Mean	23,981	82,734= Ton Cwt 36 18½		Mean	27,135	108,540 Ton Cwt =48 9		Mean	33,360	133,440 Ton Cwt =59 11¼
1 "	30,438	15,789																
Mean from above	30,788	15,556																
Mean per square inch.	153710	137160	Cold Blast. Diameter of cylinder .506 inch.	½ inch.	18,271		Cold Blast. Diameter of cylinder .6025 inch.	½ inch.	24,978		Cold Blast.	.50	28,353		Cold Blast.	.50	29,165	
				1 "	18,943			1 "	22,528			1.00	25,511			.50	29,571	
				1½ "	19,615			1½ "	22,878			1.00	25,917			1.00	27,541	
				2 "	18,271			2 "	22,878							1.00	29,165	
Mean per sq inch from the whole.	145,435 lbs. = Tons. 64	Cwts. 18½		Mean	18,775	93,385 = Ton Cwt 41 13½		Mean	23,313	81,770= Ton Cwt 36 10		Mean	26,593	106,375 Ton Cwt =47 9¾		Mean	28,860	115,442 Ton Cwt =51 10¾

Ratio of Tensile to compressive forces in Cast Iron.

Having obtained the forces per square inch necessary to tear asunder and to crush masses of cast iron of the kinds previously enumerated, we will seek for the ratio of these forces, taking the breaking weights from the preceding table and that on tension.

Description of metal.		Compressive force per square inch.	Tensile force per square inch.	Ratio.
Devon Iron,	No. 3. Hot Blast.	145,435	21,907	6.638:1
Buffery Iron,	No. 1. Hot Blast.	86,397	13,434	6.431:1
do.	No. 1. Cold Blast.	93,385	17,466	5.346:1
Coed-Talon Iron,	No. 2. Hot Blast.	82,734	16,676	4.961:1
do.	" Cold Blast.	81,770	18,855	4.337:1
Carron Iron,	No. 2. Hot Blast.	108,540	13,505	8.037:1
do.	" Cold Blast.	106,375	16,683	6.376:1
Carron Iron,	No. 3. Hot Blast.	133,440	17,755	7.515:1
do.	" Cold Blast.	115,442	14,200	8.129:1

Before quitting the subject of compression, I may mention that, in experiments upon various bodies besides cast iron, a tendency to form cones or pyramids in the fracture was observable, showing that the same laws were in operation in these as have been developed in the experiments upon cast iron. For instance, in the crushing of short cylinders of bone obtained from the thigh of an ox, fracture always took place by cones or wedges. In marble the same result was frequently observable, though less obvious than in iron, through a disposition to split in the direction of the strata.

On the power of timber of various kinds to resist a crushing force, I have, through the liberal views of Mr. Fairbairn, made a considerable number of experiments, with an apparatus similar to that employed in the crushing of cast iron, but much larger. In this material, though fibrous, fracture always took place by wedges sliding off, or by cones or wedges splitting the prism in the manner of cast iron, though at a much less angle with the horizon than in that metal. In the crushing of malleable iron likewise, short specimens always bulge out in the middle through the operation of the opposing cones or pyramids formed at their bases.

As this principle is found to obtain in the crushing of short bodies so widely different as bones, marble,* timber of all kinds, cast iron, malleable iron, we may therefore assume that it is in operation in the crushing of all rigid bodies, and consequently that, in any particular one, the resistance will be as the area of its section.

I may perhaps mention that this subject ought to be studied in conjunction with optics and crystallization. The singular structure of the mineral called analcime, or cubizite, as shown by polarized light, and given by Sir David Brewster, Optics, chap. xxv., has so much the appearance of some of our fractures, as to lead one to conceive that it may have arisen from compression.

(TO BE CONTINUED.)

* Rondelet (*Traité de l'Art de bâtir*) crushed stones of various kinds, and has given the forms of pyramids obtained from crushing prisms with square bases.

An account of the recent Progress and Present extent of Manufactures in Prussia, and of the Trade of the Prussian Commercial Union in Manufactured Goods. From German Official Documents. *By* R. W. Rawson, Esq., *read before the Statistical Society, London.*

It is chiefly the competition of Germany and Switzerland that our manufacturers profess to fear; and it is in those countries that the greatest impulse has recently been given to native industry. Switzerland, with its limited means and local disadvantages, situated at so great a distance from any sea or débouché for its products, is nevertheless able to compete, in distant lands, as well with the fabrics of Great Britain as with the finest wares of France. Germany, on the other hand, particularly those parts in which manufactures are chiefly carried on, is more favourably situated. Eastern Prussia possesses numerous ports on an accessible and much frequented sea. Saxony has an easy outlet by means of the Elbe; and the Rhenish provinces of Prussia are equally favoured by their proximity to the Rhine. Under a system of free interchange, our commercial relations with Prussia might have been very extensive. Her fields produce many articles of primary importance to us,—corn, timber, flax, hemp, &c.; while we have the means of supplying her with the produce of our colonies and of our looms. A few years ago, there were scarcely any two countries more favourably situated for commercial intercourse; but we declined receiving her produce, and there was no other country in want of it; she had, therefore, no foreign market for the surplus of her agriculture, and her means of internal consumption were proportionally crippled. Still an increasing population must be clothed, but they had no means of paying the foreigner for his stuffs: they must find a means of livelihood, but agriculture no longer adequately afforded it; hence the peasants had recourse to manufactures. A system of domestic manufacture continued for a long period, and prevails to a great extent even at the present time, chiefly in the weaving of flax and sheep's wool; for it has not been applied to that of silk, and only very partially to that of cotton. But of late years, the introduction of machinery, and the erection of large establishments upon the same extensive system adopted in this country, have carried the production far beyond the demand for home consumption, and Prussia and Saxony at present export annually a large quantity of manufactured stuffs. It is of less consequence to British interests to trace the early progress of manufactures in these countries, than to show their advance during a recent period; for this purpose a comparison is made of their condition in 1831 and 1837.—Weaving, and the preparation of yarn for the use of the looms, are the most important branches of manufacturing industry in Prussia. In general, spinning by hand is so light an employment, that it may be pursued by persons of almost any age; and it has this additional advantage, that it may, at any moment, be interrupted without injury, and resumed at pleasure. It is, therefore, well adapted for an occasional occupation, during the intervals of other labours. Weaving requires greater skill, practice, and bodily strength; but the amount for the manufacturing of plain cloths, is so small, that weaving also may be carried on to a considerable extent as an occasional employment. Agricultural families frequently weave in the spring the yarn which they have spun during the winter. The facilities which attend these two branches of labour have led to their extensive adoption throughout the whole of Prussia. Large quantities of linen and

woollen yarn are annually produced by hand; and, in 1837, there were no less than 246,294 looms occasionally employed in the manufacture of linen. Flax is by far the cheapest of the materials used in weaving, but the yarn made from it is dearer than that of cotton, because it is still chiefly made by hand. Whenever the progress of mechanics and chemistry shall render it possible to spin flax of equal fineness and at the same cost as cotton, without any great injury to its tenacity (in which consists the excellence of linen yarn,) a great revolution must take place in the agricultural, manufacturing, and commercial relations of Prussia.

Weaving is almost entirely confined in Prussia to four materials—flax, cotton, sheep's wool, and silk. According to the accounts made up to the end of the year 1837, there were, in the whole of the Prussian States, 152 establishments for spinning cotton, which contained 125,972 spindles. In the kingdom of Saxony, at the same period, there were 107 similar establishments, containing 370,805 spindles, making a total of 496,777, or nearly half a million in the two countries. So that the power of manufacturing twist in Prussia and Saxony, in 1837, was less than 1-19th, or 5¼ per cent. of what it was in the United Kingdom in 1833, and 2-5ths of what it was in the United States in 1831. But Prussia, and the States within the Prussian Commercial Union, import annually a large quantity of cotton twist, chiefly from Great Britain. The quantities of raw cotton imported into, and exported from the Union, were, in—

	Imports. lb.	Exports. lb.	Excess of imports. lb.
1835	14,285,397	3,665,532	10,619,865
1836	22,176,407	4,190,023	17,986,384

The excess of importation of raw cotton over the exportation, has increased 70 per cent. in the year 1836, compared with the preceding year; and 11-12ths of the imports were brought into Prussia. The trade of the Union in this article was as follows in 1835 and 1836:

		Imports. lb.	Exports. lb.	Excess of Imports. lb.
White single twist	1835	28,906,000	3,413,909	25,493,000
	1836	36,343,000	3,298,000	33,045,000
Double twist	1835	764,000	1,352,000	588,000
	1836	1,085,000	1,399,000	314,000

The excess of import, therefore, of single twist had increased 30 per cent., and the excess of export of double twist had decreased 46 per cent. in the latter year. Although the principal portion of the cotton twist used in Prussia is imported from Great Britain, there are 40 spinning establishments in the Rhenish provinces, containing 98,347 spindles.

Woollen yarn is partly spun in large establishments, but principally by small machines of 40 spindles; still the spinning of wool by hand has by no means ceased in Prussia, although it has become so unprofitable that it must of necessity be relinquished as the manufacture by machinery increases. Prussia is chiefly supplied with wool from her own flocks; some foreign wool is annually imported, but a much larger quantity of native growth is exported. The number of sheep in the whole kingdom in the year 1834, was 12,632,277. The number in 1831 was 11,751,603; the increase, therefore, in the three years, was 7½ per cent. But this increase was propor-

tionally much greater in the superior breeds of sheep, as will appear from the following statement:—

	Merinos and wholebred Sheep.	Half-bred Sheep.	Common Sheep.
In 1831	2,397,171	5,301,385	4,053,047
1834	2,831,553	5,839,332	3,961,392
Increase	434,382	537,947	
Decrease			91,655

Thus the best sheep had increased more than a fifth, and the middling sheep a tenth, while the number of common sheep had fallen off more than 2 per cent. As it is reckoned that the best sheep yield annually 3 Prussian pounds of wool, the middling 2¼ lb., and the common 2 lb., it is obvious that the production of wool had greatly increased during the above period. M. Ferber, who wrote upon the commerce of Prussia in 1832, estimates the average produce of wool at one stone of 22 lb. Prussia, or 23 3-5 lb. English to 10 sheep. Upon this calculation the total produce, in 1831, amounted to 27,745,248 lb. English; and, in 1834, to 29,824,497 lb., showing an increase of 2,079,249 lb., or 7½ per cent. In order to exhibit the actual consumption of the country, there must be deducted from the above quantities the difference between the quantities of foreign wool exported, and those imported during the same years, which were as follows:—

	Imports.	Exports.	Excess of Exports.
In 1831	3,936,808 lb.	8,316,772 lb.	4,379,964 lb.
1834	6,592,140	12,246,777	4,654,637

There remained, therefore, for home consumption in 1831, 23,365,284 lb.; and, in 1834, 24,169,860 lb. The wool imported is of a coarse kind, and chiefly brought from Poland. That exported consists principally of fine wool, which is shipped at Hamburgh for England.

The number of machines for spinning woollen and worsted yarn in Prussia, at the close of the year 1837, was 4,143, containing 401,210 spindles. The number of flax spinning factories was 7, containing 10,444 spindles. It appears that there were 6 similar establishments in Saxony at the same period. The extensive linen manufacture of these two countries is chiefly supplied with yarn spun by hand; and it is this employment which affords occasional occupation to a very large portion of the population both in the towns and rural districts. A large quantity of yarn, however, is imported from abroad, and the export, which was formerly considerable, is annually falling off. In 1836 the imports exceeded the exports by 2,166,785 lb. of raw, and 611,203 lb. of prepared yarn. Notwithstanding that flax is cultivated very extensively throughout Prussia, the quantities imported have generally exceeded those exported. The year 1836 was an exception; but in the five preceding years the imports, on the average, exceeded the exports by one-third. The Prussian customs' accounts do not distinguish the imports of raw silk; Ferber, in 1832, estimated the annual importation at from 670,000 to 700,000 lb. In 1837 the number of persons engaged in its production was 256, and the whole produce may be estimated at 2,150 lb. The quantity of dyed, bleached, and thrown silk imported into the Union, 1836, was 131,688 lb., and the quantity exported was 76,259 lb.

The following table will show the quantities of linen manufactures imported into, and exported from, the states comprising the Prussian Com-

mercial union in each of the three years, ending with 1836. The rates of duty on importation were, and continue to be—

	s.	*d.*	
Upon grey packing linen, or sail cloth	1	10	per cwt.
Raw unfinished linen cloth and ticking	5	7	"
Bleached, died, or printed linen cloth or ticking, table-linen, and towelling, &c.	30	8	"
Ribbons, cambric, Batist, tape, hosiery, &c.	61	4	"
Lace thread	153	4	"

There is no duty on exportation.

Description.	Years.	Import.	Export.	Excess of Export.
		lb.	lb.	lb.
Grey packing linen and sailcloth	1834	739,575	3,774,963	3,035,388
	1835	726,826	3,629,882	2,903,056
	1836	969,770	6,013,759	5,043,989
Raw unfinished linen cloth and ticking	1834	663,316	1,777,696	1,114,380
	1835	581,980	2,431,450	1,849,470
	1836	2,277,161	3,354,710	1,072,549
Bleached, dyed, or printed linen cloth and ticking, table-linen, and towelling, &c.	1834	96,913	12,007,922	11,911,004
	1835	99,633	12,553,425	12,453,792
	1836	151,102	12,949,597	12,798,496
Ribbons, cambric, Batist, tape, hosiery, &c.	1834	10,860	749,255	738,395
	1835	15,582	789,864	774,282
	1836	12,277	1,103,992	1,091,715
Lace thread	1834	2,833	6,020	3,187
	1835	2,479	5,666	3,187
	1836	2,243	6,610	4,367

The manufacture of woollens is much less extensive in Prussia than that of linen, but it is increasing. Prussia and the other states of the Commercial Union export a large quantity of woollen manufactures. The following is the amount of trade of the whole union in woollens during each of the three years ending with 1836:—

		Imports. lb.	Exports. lb.	Excess of Exports. lb.
Woollen cloths, stuffs, and hosiery,	1834	1,393,329	6,040,910	4,647,580
	1835	1,620,337	7,119,557	5,492,219
	1836	1,450,465	7,948,814	6,498,349
Carpets of sheeps and other wool	1834	19,596	56,781	37,185
	1835	20,304	67,405	47,101
	1836	25,144	72,600	47,455

From this statement it appears that the excess of exportation of woollen goods, exclusive of carpets, has increased 18 per cent. in each of the last two years above quoted.

The total cotton manufacture has nearly doubled since 1825. The number of looms at work in the whole kingdom, were—

1825	22,139
1834	31,759
1837	39,798

The following table exhibits the imports and exports of cotton goods in the Prussian dominions alone, upon an average of the three years, 1829 to

1831. Of the Prusso-Hessian league, consisting of Prussia and the two Hesses, in the year 1832 and 1833, and of the whole union, in the three following years:—

	Imports. lb.	Exports. lb.	Excess of Exports. lb.
Average of 1829-31	1,434,292	2,174,694	740,402
1832	1,671,452	3,055,574	1,384,122
1833	1,529,085	2,753,369	1,224,284
1834	1,598,380	8,848,346	7,249,966
1835	1,630,017	9,590,873	7,960,856
1836	1,594,484	9,948,324	8,353,840

Thus throughout the whole period the importations have remained nearly stationary. The exports increased to some extent in 1832 and 1833. In 1834, they rose in the proportion of 3 to 1 compared with the average of 1832-33, and of 4 to 1 compared with 1829-31.

The increase of the silk manufacture has been very rapid since 1831. The number of looms employed in the fabrication of silk and half-silk goods was—

	No. of Looms.
1831	8,956
1834	12,044
1837	14,111

The following is a statement of the imports and exports of silk and mixed silk manufactured goods from and into the Prussian Commercial Union, in the years from 1834 to 1836:—

	Silk Goods.			Mixed Silk Goods.		
	Imports.	Exports.	Excess of Exports.	Imports.	Exports.	Excess of Exports.
	lb.	lb.	lb.	lb.	lb.	lb.
1834	254,985	559,079	304,094	106,950	320,266	213,316
1835	201,981	762,004	560,023	106,596	371,971	265,375
1836	225,581	847,826	622,245	121,236	404,435	283,189

The total value of silk and mixed silk manufactures exported from the Prussian Union in 1836 is estimated at 2,726,300*l.*, of which 2,119,500*l.*, or more than three-fourths, consisted of silk, and 606,500*l.* of mixed silk goods. The imports in the same year amounted to 745,000*l.* Knitting by hand, which is carried on among the labouring population as an occasional employment, and among the wealthier classes as an amusement, continues to supply a great part of the hoisery required, at so cheap a rate that no machinery can compete with it. The shearing and finishing of woollen cloths, furnished employment at the close of 1837 to 3,480 persons. No information has been collected respecting the bleaching of linen and cotton goods, or the establishments for dyeing raw silk. The number of persons employed in other kinds of dyeing amounted, in 1837, to 7,239, of whom 3,387 were masters, and 3,852 apprentices. This number includes only the operatives skilled in this process, and not the day-labourers, who are employed in mere manual labour connected with it.

Athenæum of Science and Arts.

Observations on the application of Heliographic or Photogenic Drawing to Botanical Purposes; with an account of an economic mode of preparing the Paper: in a Letter to the Editor of the 'Magazine of Natural History.' By Golding Bird, M.D., F.L.S., &c.

Sir,—The mode of fixing the images of the camera obscura, and copying engravings, by means of the chemical action of light on paper prepared with a solution of chloride of silver, has attracted so much notice, and produced so much popular excitement, that a few observations on this interesting process will not perhaps be considered out of place in your Magazine. I venture to occupy your pages with the less reluctance, because I feel that the application of this heliographic or photogenic art will be of immense service to the botanist, by enabling him to procure beautiful outline drawings of many plants, with a degree of accuracy which, otherwise, he could not hope to obtain.

That light will act on chloride of silver is by no means a novel discovery, and paper prepared with it was long ago used by Ritter and Wollaston, in testing the chemical action of the rays of the solar spectrum; still, in this country it was not, I believe, applied to any purpose likely to be of use to the naturalist and traveller, until brought into notice by the researches of Mr. Talbot. It is not a little amusing to observe how many pretenders to the discovery have started up since the announcement of Mr. Talbot's discovery, and that of M. Daguerre in France. The latter gentleman has, through M. Arago, at a late meeting of the French Institute, announced his mode of preparing a sensitive paper, far exceeding that of Mr. Talbot in delicacy, but otherwise possessing the same property of indicating intensity of light by depth of colour, and consequently differing from that marvellous preparation which he is said to possess, and which represents shadows by depth of colour, precisely as in nature.

M. Daguerre prepares his heliographic paper by immersing a sheet of thin paper in hydrochloric ether, which has been kept sufficiently long to be acid; the paper is then carefully and completely dried, as this is stated to be essential to its proper preparation. The paper is next dipped into a solution of nitrate of silver, (the degree of concentration of which is not mentioned,) and dried without artificial heat in a room from which every ray of light is carefully excluded. By this process it acquires a very remarkable facility in being blackened on a very slight exposure to light, even when the latter is by no means intense, indeed by the diffused daylight of early evening in the month of February. This prepared paper rapidly loses its extreme sensitiveness to light, and finally becomes not more readily acted upon by the solar beams than paper dipped in nitrate of silver only. M. Daguerre renders his drawings permanent by dipping them in water, so as to dissolve all the undecomposed salt of silver.

This process is very inconvenient, for many reasons, among which are the difficulty of procuring, as well as the expense of, hydrochloric ether: on this account I prefer Mr. Talbot's process, although it is to be regretted that this gentleman has not stated more explicitly the proportions in which he uses the ingredients employed in the preparation of his sensitive paper. I have performed a set of experiments on this subject, and can recommend the following proportions as the most effective and economical. 200 grains of common salt are to be dissolved in a pint of water, and sheets of thin blue wove post paper saturated with the solution, which, for this purpose,

should be poured into a dish, and, the paper being immersed, the application of the solution to every part should be ensured by the use of a sponge. The paper is then to be removed, drained of its superfluous moisture, and nearly dried by pressure between folds of linen or bibulous paper.

240 grains of fused nitrate of silver are then to be dissolved in 12 fluid ounces of water, and this solution is to be applied by means of a sponge to one side of each sheet of the previously prepared paper, which side should be marked with a pencil, so that when the paper is fit for use the prepared side may be distinguished. The sheets of paper are then to be hung upon lines in a dark room to dry, and when nearly free from moisture, their *marked* sides are be once more sponged over with the solution of silver, and finally dried; they are then to be cut into pieces of convenient size, and preserved from light, or even too much exposure to air, by being wrapped up in several folds of brown paper, and kept in a port folio.

The proportions above recommended are sufficient for the preparation of a quire of the kind of paper alluded to; if more of the salt of silver were used, the paper would indeed become darker by the action of light, but its expense would be proportionally increased: and when prepared in the manner directed, it assumes, by less than a minute's exposure to the rays of the sun, a rich mulberry brown tint, of sufficient intensity to define an outline very beautifully, which indeed is all that is required.

To use this paper, the specimen of which a drawing is required, is removed from the herbarium, placed on a piece of the paper, and kept *in situ* by a pane of common glass pressed by weights: a piece of plate glass, however, is preferable, as it is sufficiently heavy to press the plant close to the paper. The whole is then placed in the sunshine, and in less than a minute all the uncovered parts of the paper will resume a rich brown tint. The paper should then be removed from the direct influence of the sun, and placed in a book until the drawing be rendered permanent: the specimen, quite uninjured by the process, may then be replaced in the herbarium, and the drawing of another be taken, and so on. So rapidly is this process executed, that twenty-five or thirty drawings may be obtained in an hour, provided we are favoured with a direct sun-beam; if, however, we have only the diffused day light, five or ten minutes, and sometimes even more, are required to produce a drawing with well-defined outlines.

If drawings of recent plants be required, specimens of proper size should be cut, and if not too rigid, placed on a piece of the paper, and kept in a proper position by means of a pane of glass, as in the case of dried specimens; but if the plant be rigid, the specimens should be placed for twenty-four hours between folds of blotting paper, under a heavy weight, before placing them on the sensitive paper.

Having obtained as many drawings as are required, the next thing is to fix them, so that their otherwise evanescent character may not deprive them of their value. For this purpose place them in a dish, and pour cold water over them; allow them to soak for ten minutes, and then transfer them to, or sponge them over with, a solution, made by dissolving an ounce of common salt in half a pint of water, to which half a fluid ounce of the tincture of the sesqui-chloride of iron has been added. The drawings thus prepared may be dried by pressure between folds of linen, and exposure to the air; and may then be examined without danger. On looking at them every one must be struck with the extreme accuracy with which every scale, nay, every projecting hair, is preserved on the paper; the character and habit of the plant is most beautifully delineated, and if the leaves be

not too opake, the venation is most exquisitely represented; (this is particularly the case with the more delicate ferns, as *Polypodium Dryopteris.)* Among those classes of plants which appear to be more fitted than others for representation by this process, may be ranked the ferns, grasses, and umbelliferous plants; the photogenic drawings of the former, are indeed of exquisite beauty.

The fact of the object being white on a brown ground does not affect the utility of this mode of making botanic drawings; indeed I almost fancy that their character is better preserved by this contrast of tint, than by a coloured outline on a white ground. Every one will be fully aware of the value of this process to the botanist, in obtaining drawings of rare plants preserved in the herbaria of others, and which he would otherwise have probably no means of obtaining.

If the drawing of a tree or large shrub be required, a box, blackened inside, having a hole at one end about 1¼ inch in diameter, must be provided; in this hole should be placed a lens of 5 or 6 inches focus; if one of longer focus be used, the dispersion of light becomes too great to ensure an accurate representation. When the tree or shrub is well illuminated by the solar beams, the lens should be presented towards it, at a distance varying of course with the height of the object. A piece of card-board should then be placed in the box, a little beyond the true focus of the lens, and the former moved until a well defined bright image of the tree, &c. is formed on the card, of course in an inverted direction. The box is then to be placed on any convenient support in this position, and a piece of the prepared paper fixed on the card, the lid of the box is then to be closed, and the whole left for half an hour, at the end of which time a beautifully accurate outline of the object will be found on the paper, which is then to be rendered permanent in the usual manner. It is obvious that this plan is unavailable on a windy day, on account of the branches of the tree, &c. being continually moving, so that it is of far less use to the botanist than the above described process for obtaining drawings of small specimens.

Various other applications of this paper will suggest themselves to the minds of naturalists.

Messrs. Herapath and Cox's new process of tanning. By Stephen F. Cox.

Sir,—For some time past I have been working in my tannery upon Messrs. Herapath and Cox's new method of tanning, under license from the patentees, and have much pleasure in bearing testimony to the value of the process, and in corroborating the remarks of your correspondent, Mr. E. Wilkins, tanner, and currier, of Southampton, whose letter, inserted in your valuable Magazine, No. 804, I have read.

I should premise that I am a tanner of butts for sole leather from South American hides; that my accustomed time for the tanning process by the old mode has been twelve months; that my tanning ingredients are English bark and Smyrna valonia, in about equal proportions; and that during the time in which I have been tanning and selling nearly fifteen hundred butts upon the new plan, it has been personally superintended by myself. I do not rely, therefore, upon the dictum of others.

The following is a comparative statement of actual results produced by the new method upon five different lots, amounting to 497, and by the old

method upon four lots, amounting to 425, salted Buenos Ayres and Monte Video hides.—See following table.

By this statement it will be seen that the *new process* has produced *in three months* 3 4-8 *lbs. more leather from a* 58 *lb. hide,* than is produced by the *old method in twelve months from a* 59 1-5 *lb. hide.*

These hides were bought in Liverpool by the same agents, were of similar quality, were tanned in the same yard, in the same year, with the same ingredients, *and no stronger liquor was administered to those operated upon by the patent process* than to the others. I have selected the above quantities out of many others, because, both in numbers as whole lots and in their average as hides in their raw state, they approximate nearer, and of course give a more correct comparison, than any others I could take. The time taken to tan those upon the patent mode has varied; some have had *three months tanning*, whilst some have been brought *from the bundled state of salted hide to the market in two months and twenty-one days.*

With respect to colour, I produce what I please, from a dark brown to a straw; but the chief recommendation of sole leather tanned by the patent process is its *impermeable, elastic, and durable qualities;* so that its advantages to the consumer are even greater than to the tanner. I could bring proof upon proof to substantiate this assertion from my numerous customers, for the use of this leather in coal mines, engine manufactories, iron foundries, and public works, as well as from public and private individuals who have long used and tested the leather.

	No. of Hides.	Net payable weights of Hides.			Payable average of Hides.		No. of butts, shoulders and bellies.	Net weights of butts, shoulders, and bellies.			Net average of butts, shoulders, and bellies.	Total weight of leather.			Total weight of leather per Hide.
		cwt	qr	lb.	lb.			cwt	qr	lb.	lb.	cwt	qr	lb.	lb.
New method	497	257	1	15	58	Butts	497	137	0	12	30 7-8				
						Shoulders	497	11	2	27	2 5-8				
						Bellies	994	40	2	25	per pair 9 1-5	189	2	8	42¾
Old method	425	224	2	13	59½	Butts	425	103	0	9	27 1-6				
						Shoulders	425	12	1	10	3 1-4				
						Bellies	850	33	2	25	per pair 8 7-8	149	0	15	39¼

This simple statement of *facts* I leave for the consideration of your readers, and in conclusion beg to observe that I shall be happy to answer any inquiries which may be made of me through the medium of your Magazine in a straight forward and open manner, and as strictly correct as the close attention I have given to the process.

[The following are descriptions of samples which we have received from Mr. Cox, of leather tanned upon Herapath and Cox's patent process, and which we shall be happy to show any parties interested who may call at our office.—Ed. M. M.

No. 1, a piece of shoulder cut from a well-grown Buenos Ayres hide, tanned in three months.

No. 2, a piece of very coarse hide cut from the belly inwards, tanned in ten weeks.

No. 3, a piece of Monte Video hide cut from near the back, of a milder tannage, and softer finish and lighter colour than the two former, tanned in eight weeks.

No. 4, a firm, prime, and bright coloured, piece of Buenos Ayres salted hide cut near the ribs, limed, tanned, *dried, and sent to market, in two months and twenty-one days!*

No. 5, a milder tanned piece of bright coloured leather cut from flank and belly inwards, tanned in seven weeks.

The most impermeable pieces are Nos. 1 and 4. No. 1, although a shoulder, and consequently a loose part, will bear soaking for twenty-four hours without saturation. Mech. Mag.

Mr. Crosley's Pneumatic Telegraph.

In establishments where the telegraphic communications do not require the constant attendance of a person to observe them, and where periodical attendance is sufficient, the signals may be correctly registered on paper, by connecting with the air-tube an instrument called a *pressure register*, invented by the projector of the *pneumatic telegraph*, which has been successfully employed in large gas light establishments upwards of fourteen years, for registering the variations of the pressure of gas in street mains. The same instrument produces, also, an increased range of the index scale, by which means the chance of errors from *minute divisions* is obviated.

It may be observed, that the introduction of railways has not only created an additional use for telegraphic communications, but the important difficulty which previously existed in the expense of providing a proper line and safe foundation, is at once removed by the site of the railway itself, possessing as it does, by its police, the most ample security against injury, either to the tubes or electric wires.

There being now three different projects for improvements in telegraphic communications, viz. the electro magnetic, the hydraulic, and the pneumatic telegraph,—and assuming that such improvements are of importance to the state, as well as to railway proprietors and the community at large, it seems desirable that their merits should be thoroughly investigated by competent engineers, and that the joint aid of Government should be solicited, in conjunction with that of railway proprietors, for the purpose of establishing, on a practical scale, the most eligible project.

The prominent questions for consideration seem to be—the certainty and accuracy of the communications, the first cost, the expense of repair and superintendence, also the time required for transmitting intelligence.

On the question of time, it is quite clear that neither the hydraulic nor the pneumatic can compete with the electro-magnetic telegraph in rapidity. No doubt, on investigation, each project will be found to possess its peculiar advantages. Thus, in considering the advantage one may have in point of time, another may possess a greater degree of certainty or accuracy in the communication, sufficient to outweigh the difference of time, for instance, between 1 second and 1 minute, or even between 1 second and 5 or 10 minutes.

The time occupied in transmitting intelligence by the pneumatic tele-

graph will depend on the capacity of the air tube, the degree of compression given, and the distance between the stations, but should greater despatch be required than is afforded by one tube, and the cost be of minor importance, several tubes may be employed, each fitted in the manner above described, so that all the figures contained in one telegraphic number, may be communicated at once with four tubes. Nine thousand nine hundred and ninety nine different signal numbers may be communicated, referring to so many words or sentences, and these numbers may be multiplied fourfold by letters A, B, C, &c., as indices to distinguish each series.

The projector of the *pneumatic telegraph* is not in possession of any results of experiments on a practical scale by the electro magnetic or by the hydraulic telegraph, employed at any considerably extended distances; or of their continued operation for any considerble period of time; nor can he offer much decisive information, of a practical nature, analogous to the long pneumatic telegraph on these points; the following circumstances may, however, be referred to:

There has been upwards of twenty years' experience in the transmission of gas for illumination through conduit pipes of various dimensions. In several instances, the gas has been supplied at the distances of from five to eight miles by low degrees of pressure. As one proof of great rapidity of motion, it has been observed, that when any sudden interruption in the supply has occurred at the works, the extinction of all the lights, over large districts, has been nearly simultaneous. Another instance of the great susceptibility of motion which frequently happens, is the flickering motion of the lights at great distances when water has accumulated in the pipes.

The only experience in the transmission of atmospheric air through conduit tubes, which applies more particularly to this question, may be referred to at three railway establishments; viz. Edinburgh, Liverpool, and Euston-square, London. In these establishments, air-tubes, from $1\frac{1}{4}$ to 2 miles in length, have been employed for the purpose of giving notice when a train of carriages is ready to be drawn up the inclined plane by the stationary engine at the summit, so that it may without delay be put in motion. This notice is communicated by blowing a current of air through the tube at the foot of the inclined plane, and sounding an organ-pipe, a whistle, or an alarm bell at the stationary engine. It will be satisfactory to know, that this operation has been regularly performed from two to four years without one single failure or disappointment. Lond. & Edin. Philos. Mag.

Description of a Compensating Barometer, adapted to Meteorological purposes, and requiring no corrections either for Zero, or for Temperature. By Samuel B. Howlett, Esq., *Chief Military Draftsman, Ordnance. Communicated by* Sir John F. W. Herschel, Bart., K.H., V.P.R.S., &c.

In the instrument here described, there is provided, in addition to the ordinary barometric tube (inverted, in the usual way, in a cistern of mercury,) a second tube of the same dimensions, placed by the side of the former, and likewise filled with mercury, but only to the height of twenty-eight inches above the level of the mercury in the cistern. This tube is closed at its lower end, and fixed to a float supported by the mercury in the cistern: and it bears, at its upper end, an ivory scale, three inches in

length. The elevation of the mercury in the barometric tube is estimated by the difference between its level and that of the mercury in the closed tube; and is measured on the ivory scale by the aid of a horizontal index, embracing both the tubes, and sliding vertically along them. As the float which bears the closed tube, to which the scale is attached, rests freely on the mercury in the cistern, and consequently always adjusts itself to the level of that fluid, no correction for the zero point is needed; and as every change of temperature must similarly affect the columns of mercury in both the tubes, after the scale has been adjusted so as to read correctly at any given temperature, such as 32°, which may be effected by comparison with a standard barometer, every other reading will correspond to the same temperature, and will require no correction. The author considers the error arising from the difference of expansion corresponding to the different lengths of the two columns of mercury, and which will rarely amount to one four-hundreth of an inch, as too small to deserve attention in practice, being, in fact, far within the limits of error in ordinary observations.

Idem.

Invention of Photogenic Drawings.

It appears from an article in the London Athenæum, that a M. Niepce had entered upon the investigation of this mode of copying, quite as early as M. Daguerre. The former was in England in 1827, and left with some of his friends there several specimens of his execution, nearly as perfect as those now produced. It appears however, that "he was long and zealously assisted by M. Daguerre, who had been many years engaged in similar pursuits; and there is legal proof that, so early as 1829, they entered into an agreement, by which they declare themselve *'associés pour exploiter le procédé á l' invention duquel ils avaient concuru l'un et l'autre.'*

But the most curious fact, (adds the Athenæum,) in relation to this discovery remains to be told. It would appear, considering the character of the pictures, all but impossible that impressions from them could be multiplied after the manner of an engraving; M. Daguerre, indeed, stated to us that it was impossible, and it is but reasonable to believe that he is as fully informed of the nature and extent of the discoveries as M. Niepce himself. Yet, in 1827, M. Niepce not only declared that it was possible, but produced specimens of such multiplied copies, and Mr. Baner has now in his possession, not only copies of engravings, fixed permanently by the action of light, not only scenes from nature, *but metallic plates engraved, and engravings copied from them:* and he understood and believes that no engraving tool was used, but that *the drawings were fixed by the action of light, and the plates subsequently engraved by a chemical process, discovered by M. Niepce.* If so, the greatest secret of all remains yet to be made public, and is, we believe, as unknown to M. Daguerre as to others. Mech. Mag.

Light Drawn Pictures.

Our vivacious Parisian neighbours have certainly the facility of making the most, in words, of anything they chance to lay hold of. "M. Daguerre's ingenious discovery," says the Paris correspondent of the *Post*, "which has assumed the name of 'Daguerrotype,' continues to excite very great curiosity and admiration. It is affirmed that the Emperor of Russia has of-

fered 500,000f. for his secret, and that he has declined the munificent reward. It is not likely that his friend, M. Arago, will succeed in obtaining a larger national one from the Chambers." Mr. Talbot's communications to the Royal Society have made the processes public property here, had they not been so before. Sir John Herschel has turned his attention to the subject and has already obtained pictures from the light of Daniell's great galvanic battery; Sir David Brewster too, has commenced an investigation into the matter. Idem.

To the Editor of the United States Gazette.

Dear Sir:—A scientific friend having kindly sent to me, from Paris, a paper containing the authorized explanation of the process of M. Daguerre, which has attracted so much attention, I have made an abstract of it, which is at your service. The condition under which M. Daguerre received a pension from the French Government was, that he should make all the steps of his process public. His communication was first made confidentially to a Committee of the Institute, and M. Arago, acting as their organ, states that some of the steps of the process are not explicable by known laws. Yours, A. D. B.

The Daguerrotype Explained.

The Academies of Sciences and of Fine Arts of the Institute, met on the 19th of August last, to hear the explanation of the process of M. Daguerre, from the perpetual Secretary, M. Arago.

It appears that in the earlier attempts to form a permanent picture of external objects, by the aid of the camera obscura, chloride of silver was used as in the method of Photogenic Drawing of Mr. Talbot. In this case the light blackens the paper, the depth of the shade being proportionate to the intensity of the light; the lights are thus represented by dark parts of the picture, and vice versa. M. Niepce first ascertained that an effect the reverse of that just mentioned might be produced by using a particular kind of bitumen, dissolved in oil of lavender, and that this picture might be preserved. The picture formed upon the bitumen required, to render it fully visible, the use of petrolium, which acted upon the parts of the picture not affected by the light. This process was a very imperfect one, requiring a long time for its execution, and yielding but imperfect results. The invention had been brought to this stage, when M. Daguerre undertook to improve it; by many curious experiments, and much labor, he was gradually led to his present process, the details of which present some very strange, and so far unexplained phenomena.

A sheet of copper, plated with silver, is carefully cleaned on the silver side by the aid of nitric acid. The cleansing requires great care and especial precaution, the plate requiring to be rubbed backwards and forwards in a fixed direction. Plated copper is found to answer better than silver. The plate thus prepared is exposed to the action of the vapour of iodine. For this purpose, it is placed in a box upon the bottom of which a small quantity of iodine is strewed, separated from the plate by a gauze screen, so as to diffuse the vapour uniformly. The plate must be enclosed in a metallic frame, to prevent the vapour from acting more upon the edges than near the centre, the success of the whole operation depending essentially

upon the uniformity of the coating of iodide of silver, which is formed upon the surface of the plate. A yellow tint indicates that the plate has been sufficiently long exposed to the action of the vapour. It is then transferred to the camera obscura carefully excluding it meanwhile from the light. M. Daguerre is understood to have made some improvements in this instrument; to understand the progress of the present operation, however, it is only necessary to observe, that a plate of ground glass having been previously placed so as to receive a distinct image of the object to be delineated, the prepared silver plate is substituted for it. The effect is immediate, but is only very slightly preceptible. The plate is next exposed to the action of the vapour of mercury, and a condition stated to be essential is, that it shall be placed under a particular angle. It is therefore placed in a second box, at the bottom of which is a small trough of mercury, heated to between 160° and 170° Fahrenheit, and if the picture is to be viewed when hanging vertically, the inclination of the plate to the surface of the mercury must be 45°. The vapour of mercury appears to affect only the parts which have been already acted upon by the light, forming, probably, an amalgam of mercury and silver. After this operation the plate is dipped into a weak solution of hypo-sulphite of soda, and then washed with distilled water. The process is now complete, and the plate presents a drawing in which the light and shade is truly represented, and which may be exposed, without change, to the action of light.

Progress of Civil Engineering.

Clegg's Patent Atmospheric Railway.

The idea of employing the pressure of the atmosphere as the tractive force for propelling railway carriages has long been entertained; it was brought forward by Mr. Vallance several years ago, but in a form so crude and impracticable as to receive but little attention. It was again revived by Mr. Pinkus in his "Pneumatic Railway" scheme, but without success, although the apparatus was very ingeniously constructed. The subject has now, it appears, been taken up by Mr. Clegg, whose mechanical abilities are well known, and the pamphlet before us records the successful results of this gentleman's late experiments at the Southwark Iron-works, belonging to Messrs. Samuda, of which an account appeared in the *Mining Journal*, at the time.

We extract entire the following account of the invention and the experiments, with their results:—

"Clegg's atmospheric railroad is worked by stationary steam-engines, apart from each other two to five miles, according to the nature of the country. Two engines are fixed at each station, one for the up and the other for the down main, excepting on long inclined planes, where one engine only is required at the same points.

"The power of these engines varies according to the gradients and traffic. Supposing the traffic to be 2500 tons per day, say 1250 tons each way, and the velocity required to be thirty-five miles per hour, the average power employed on the line would be equal to six-horse per mile. The size of the engines will vary from six to twenty-five horse power, accord-

ing to the gradients. The power is communicated to the train by means of a main or pipe laid between the rails, which is exhausted by air-pumps worked by the engines. This pipe is divided into lengths or sections (varying according to the respective distance of the engines) by valves, which are opened by the train as it goes along; and a space is left between each section, with proper sidlings for stopping the trains when necessary. The pipe suited to the above mentioned traffic would be ten inches in diameter. A piston is fitted to the pipe in such a manner that it will slide air-tightly therein. The pressure on the back of the piston (when the pipe is exhausted to the degree required for the steepest ascents) will produce a vacuum equal to a column of mercury twenty inches high.

"An available tractive force is thus obtained of 714 lbs., which will draw a train weighing thirteen tons up an ascent of one in fifty. With engines of the before named power, the train can be impelled at the rate of thirty-five miles per hour, and the sections of the pipe exhausted with sufficient rapidity to admit of a train being dispatched each way every ten minutes; or, if we make allowance for all possible delay, four trains each way may be transmitted per hour, making a total of 2496 tons per day.

"To the first, or driving, carriage of the train an arm from the piston is attached. This arm passes through an opening about an inch and a half wide, extending the whole length of the pipe on its upper surface; and this opening is covered by a valve, the nature of which constitutes the peculiarity of Mr. Clegg's system; and is, by a simple and efficacious contrivance rendered absolutely air-tight. The construction and action of this valve cannot be clearly explained without reference to diagrams or models, but the following account of experiments made by Messrs. Samuda, at Southwark Iron-works, will be sufficient to prove its efficacy:—

"The first of these experiments was made with a pipe three and five-eighth inches diameter, and thirty feet in length, which was laid level, and was exhausted by an air-pump of twelve inches diameter, worked by four men. Although the joints were but roughly and imperfectly made, a vacuum was attained when both ends of the pipe were plugged, equal to a column of twenty-five inches mercury, and but little less when the piston was in the pipes. This piston raised eighty-four pounds weight perpendicularly over a pulley, besides drawing a carriage on the railway, which weighed 160 lbs.

"The next trial was made on an ascent of one in thirty, with the same air-pipe, but increased in length to 102 feet, and exhausted by the same air-pump, which was on this occasion attached to the steam engine at the works. A cock was also placed close to the pipes, to separate them from the pump, when required for the purpose of better ascertaining the leakage in the pipe itself. A vacuum gauge was attached to each end of the pipe, to ascertain the time that would be required to obtain an equal vacuum throughout its whole length. On this occasion the carriages, which were loaded with iron, weighed *twenty hundred weight*, and were drawn up with great ease. The vacuum at both ends of the pipe was obtained at the same moment of time, and the two gauges rose and fell simultaneously. In order to ascertain the real leakage in the pipe and continuous valve, the ends of the pipe were plugged, when the vacuum gauge rose to twenty seven and three-fourth inches of mercury. The cock was then shut, and the mercury was six minutes in descending, showing a leakage in 102 feet length of pipe of only three fourths of a cubic foot per minute.

"The main pipe is put together with deep socket joints, in each of which an annular space is left about the middle of the packing, which is filled with a fluid, and thus any possible leakage of air into the pipe is prevented. Should the fluid pass through the packing, a circumstance very unlikely to occur, it can be easily replenished.

"A receiver is attached to each steam-engine, having an internal capacity as large as the section of pipe which the engine has to exhaust. This receiver is exhausted by the air-pump when the train piston is not in the pipe, so that the engines are constantly at work, after one train has passed generating power for the next. The pipe itself is also exhausted in the interval between the exit of one train and the entrance of another. No pipe is laid on a descending plane, except where that descent occurs in the middle of a section, in which case the pipe has no valve or lateral opening, and is laid below the surface. Whenever a train has passed out of a section of pipe, the pump is employed, first, to exhaust the receiver to the greatest possible degree, and then to exhaust the pipe to the degree required for the train."

We find that the estimated expense of a railway, constructed on Mr. Clegg's principle, falls short of 10,500*l.* per mile, the present cost being, as is well known, about 40,000*l.* It is also estimated that the current expenditure will be greatly reduced by the new plan. We do not pretend to offer any hasty opinion of the merits of a system which, if successfully carried out, promises to embrace such extensive results, but we consider that it possesses strong claims upon the attention of engineers, and all who are interested in railway undertakings. Min. Jour.

Dublin and Kingstown Railway.

April 11, an adjourned meeting of the shareholders was held for the purpose of considering the propriety of a rise in the fares of the 2d class carriages from 8*d.* to 9*d.* per passenger. The English proprietors were those who were most anxious for the rise. There was indeed a division at the board on the subject, some directors advocating a rise and others not. Ultimately, the resolution was carried for the rise in question, by 345 to 208, to commence May 1st instant. It appeared in the course of the discussion, which was long and animated, but conducted with great good feeling, that the railway was originally to cost 150,000*l.* and to pay 20 per cent. profit. It, however, cost nearly 300,000*l.* and paid only about 4¼, though the income is progressively increasing.

Out of an income of 35,000*l.* per annum, owing to the interest of borrowed capital and expenses, only 6,000*l.* is left to be divided among the proprietors. [Is there not a sinking fund going on to pay off 100,000*l.* borrowed of the Government, which is the main cause of so small a part now divided among the proprietors?—Ed.] Several gentlemen, as Mr. Cadbury, Mr. Kincaide, Mr. Twigg, Mr. Palmer, Mr. Roe, Mr. Barton, &c., addressed the meeting, some for, and some against the proposition. Mr. Pimm, jun. (we believe the secretary), having been called on to give his opinion, argued very satisfactorily against the advance, though for the sake of unanimity, he would vote for it. He was an advocate for even lowering the 3d class prices from 6*d.* to 4*d.*, for which he adduced several good prac-

tical arguments. Mr. Pimm observed:—"The Brussels and Antwerp Railway is 27½ miles in length, and that between Liverpool and Manchester 30 miles, the difference in length is immaterial. During the year 1836, 523,000 persons travelled by the Liverpool line, and 873,000 by the Brussels line, but great as the difference is it becomes more striking when the relative amount of the population is considered. In Liverpool, Manchester, and Warrington, the population is 486,000, and in Brussels, Antwerp, and Mechlin, only 209,000. The increase is easily accounted for—the corresponding fares are—

Liverpool and Manchester.			Brussels.	
s.	*d.*		*s.*	*d.*
6	6	. . . . .	3	0
5	6	. . . . .	2	6
4	0	. . . . .	1	2

But the results elsewhere are equally striking. On the Paris and St. Germain Railway, 12 miles in length, the lowest rate was 10*d.* There were no complaints at either side, but the directors of that company, on calculating that they could convey a much greater number without adding materially to their expenses (exactly our case), came to the resolution to lower the fares to 15 francs [cents?] (7½) for the 12 miles. The result has been such an increase of passengers as considerably to increase their income (hear)."—Abridged from *Saunders's News Letter.* We confess our opinion goes with Mr. Pimm, very forcibly advocated by Mr. Twigg. The Dublin and Kingstown Railway is only 6 miles long, and if any alteration was to be made in the fares, we should be inclined to reduce them from 1*s.*, 8*d.*, and 6*d.*, to 9*d.*, 6*d.*, and 4*d.*, or 3*d.*; we feel persuaded it would tell better to the company in the end. It is a fact apparently strange, but, when examined, very easy to be explained, that an engine in an ordinary passenger-train will take along 60 or 80 persons with little or no sensible difference in the expense to that which is required to carry 20 or 15. This we were informed was observed years back on the Liverpool and Manchester line, and as Mr. Pimm justly observes, has been since noticed on the Paris and St. Germain Railway. Our sagacious neighbours immediately saw the account to which it might be turned, and reduced their fares from 1 franc, or 10*d.*, to 15 cents, or 1½*d.* The consequence, as Mr. Twigg says, was an increase in 12 weeks, from 91,000 to 130,000; and as Mr. Pimm observes, "such an increase of passengers as considerably to increase their income." So great a reduction, however, was carrying the principle too far, and nothing but the almost exhaustless resources of a capital to draw the traffic from could justify it.

Railway Mag.

Side motion (or rocking) of Railway Engines effectually prevented.

Sir,—My attention having been drawn to the lateral and shaking motion of engines upon railways, and believing it to be in proportion to the weight of the cranks and gearing, and the position in which the outside cranks, if any, are placed, I made a small model of the engine crank shaft with two wheels upon it, in the proportion of one inch to the foot, which I placed upon two strong upright wires, the wires made fast in a piece of board. I attached a weight to a string wrapped round the middle of the crank shaft, for the purpose of giving a certain degree of velocity to the crank and wheels, by falling a certain distance, say from the table to the floor. The weight I attached would turn the shaft and wheels 75 seconds,

and the swing of the cranks produced *a lateral and oscillating motion* sufficient to cause the model to move, or jump, across the table on which it was placed. I then placed a weight on each wheel sufficient to *balance the cranks*, and with the same weight to give motion, and traveling the same distance as in the first case would turn the crank shaft and wheels, although heavier than before, 90 seconds, and the model stood steady where it was placed upon the table.

I submitted my experiments to the Engineers of the London and Birmingham Railway, who, instructed by the Directors, ordered one of the Company's engines (the Brockhall, at that time under repair at Mr. Middleton's, the Vulcan Iron Foundry, Birmingham,) to have balance weights applied to it, according to my plan, and under my superintendence. The engine when set to work, with the balance weights on the wheels, had one uniform steady pull at its work; the side sway was gone; it ran equally steady, whether it made 6 or 160 strokes per minute, which is not the case with railway engines generally, for the greater the speed the greater the snatching and swinging motion. After the engine had worked seven weeks, and had acquired the reputation of a very steady engine, I, with the consent of the engineers of the railway, removed the *balance weights* from the wheels and found the same snatching and swinging motion with this engine as is common to all locomotive engines of the usual construction; I found that, the engine, when running at, or upwards, of 22 miles per hour, would advance and recede from and to the tender from three-quarters of an inch to an inch every stroke of the engine, and proved the advantage of the balance on the engine equal to the effect on the model. Persons acquainted with railway locomotion will from the foregoing statements, readily see the great and many advantages to be derived from so simple and yet so effective an arrangement.

Yours respectfully, G. Heaton.

P.S.—Since writing the above, I understand the spirited and enterprising manufacturers of the Brockhall engine, have judiciously applied my balance weights to some new locomotive engines lately sent out by them. G. H.

Lond. Mech. Mag.

Mechanics' Register.

Cost of a Patent.

As many of our readers may wish to know the cost of that curious piece of furniture, called a "Patent for Invention," we subjoin the amount of fees payable on a patent of not more than one skin of parchment, granted to a single individual. If there be more than one patentee, or more than one skin of parchment, or if the patent be opposed, the charges are considerably increased in England:—

Reference to Attorney-General	£2	2	6
Royal warrant	7	13	6
Queen's bill	7	13	6
Privy Seal office	4	2	0
Clerk of the Patents' office	15	14	0
Hanaper and Great Seal office	48	7	6
Fee at Attorney-General's chambers	4	4	0
Signet office	4	7	0
Cost of a patent in England	£94	6	0

Cost of a patent in Ireland . . .	106	17	7
Cost of a patent in Scotland	46	4	0

Min. Jour.

The New Light in the House of Commons.

The House of Commons on Saturday evening, was fully lighted for the first time with Gurney's Bude light, in the presence of several of the Ministers, and of a great number of members. The light is brought into the House on catoptric, and diffused on dioptric, principles, so that while it is exceedingly brilliant and effective, it is soft and pleasant. The lights are placed out of the House above the roof, and being insulated by plate glass, ventillation may be carried upwards or downwards, which is an important point. Of the various media through which the light was diffused, that of the crystal octohedron facets, combined with prisms, seemed to be the most generally admired. We understand that this light, which may be regarded as a new era in the science of illumination, is due to the public spirit of the Elder Brethern of the Trinity House, at whose expense the Bude light has been perfected for the greater security of our merchantmen and navy.—*Globe.*

Lond. Mec. Mag.

LUNAR OCCULTATIONS FOR PHILADELPHIA, NOVEMBER, 1839.

Angles reckoned to the right or westward round the circle, asseen in an inverting telescope. ☞ For directvision add 180° ☜

Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
14	6	32	Im. 42 Aquarii	6	101°	101°
14	7	41	Em.		336	351
15	5	44	Im. Uranus		126	103
15	7	2	Em.		312	307
17	6	2	Im. 60 Piscium	6	96	54
17	7	0	Em.		341	307
17	7	6	Im. 62 "	6	161	129
17	8	6	Em.		277	261
19	7	37	N. App. ☽ & μ Arietis 6, ☽ South 3.'8			
19	15	37	Im. ϵ Arietis	6	89	144
19	16	33	Em.		299	352
20	6	32	Im. *g* Pleiadum	5,6	156	100
20	7	12	Em.		251	194
20	6	19	Im. *b* "	4,5	118	63
20	7	13	Em.		289	232
20	7	6	N. App. ☽ & *e* Pleiadum 5, ☽ South 2.'2			
20	6	54	Im. *c* Pleiadum	5	151	95
20	7	38	Em.		256	199
20	6	59	Im. *d* "	5	47	351
20	7	21	Em.		1	304
20	7	23	Im. *a* "	3	63	6
20	8	0	Em.		346	290
25	13	49	Im. *q* Cancri	6	23	290
25	14	45	Em.		332	245
27	16	57	Im. *c* Leonis	5,6	86	58
27	18	5	Em.		193	186

Railway Mails.

A very ingenious apparatus has just been erected by order of government on the railroad from London to Liverpool, for exchanging the letter-bags conveyed by the traveling post-office, without in the least checking the speed of the steam-carriage. The bags are now taken and left, at any rate of speed, however rapid, at which the train may be traveling, thus considerably expediting the transit of correspondence, effecting a vast saving in the consumption of steam power, and though last, not least, in importance, getting rid of the liability of serious accidents to the parties employed in exchanging the bags in the old mode. Min. Jour.

Powers of Machinery.

In one branch alone (the cotton trade), some spindles, which, before the new improvements were projected, used to revolve fifty times in a minute, now perform six, seven, and in some cases, 8000 revolutions, in the same short space of time. In one establishment at Manchester, there are 136,000 spindles kept in incessant motion by steam power, by which they are enabled to spin 1,200,000 miles (not yards) of cotton thread per week. The weekly produce of this article, when the machines are in full work is about 400,000,000 of miles, or enough to encompass the earth 160 times. Ibid.

Meteorological Observations for May, 1839.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	56	62	29.78	29.78	S.E.	Moderate.	.14	Rain—do.
	2	58	76	.64	.65	S.E.	do.	.81	Drizzle—rain.
	3	50	64	.90	.90	W.	Brisk.		Clear—do.
	4	39	54	30.00	30.05	W.	do.		Clear—do.
	5	42	69	.00	29.85	S.W.	do.		Clear—do.
☽	6	46	68	.05	30.05	W.	Moderate.		Clear—do.
	7	60	68	.04	29.96	W.	do.		Clear—lightly cloudy.
	8	48	79	.05	30.00	E.S.E.	do.		Clear—cloudy.
	9	62	81	29.85	29.85	W.	do.		Partially cloudy—do.
	10	56	62	30.03	30.03	N E.	do.		Cloudy—do.
	11	40	70	.00	.00	N.E.	do.		Clear—do.
⊗	12	44	72	29.93	29.93	W	do.		Clear—do.
	13	48	72	.95	.75	E.S.	Brisk.		Lightly cloudy—do. do.
	14	54	67	.55	.55	N.W.	Moderate.	1.15	Rain—Clear.
	15	51	80	.74	.60	W.	do.		Clear—do.
	16	60	82	.75	.75	E.S.W.	do.	.05	Clear—flying clouds—aain.
	17	54	72	.76	.80	N.W.	do.	.22	Clear—shower.
	18	52	64	.90	.90	E.W.	do.		Cloudy—clear.
	19	52	75	.95	.95	W.	do.		Clear—do.
☾	20	55	83	.80	.80	W.	Brisk.		Clear—do.
	21	60	76	.75	.75	E.	Moderate.		Cloudy—do.
	22	63	76	.70	.70	E.	do.	.50	Partially cloudy—rain.
	23	52	57	.95	30.00	E.	do.	.36	Cloudy—rain.
	24	53	67	.95	29.90	E.W.	do.	.36	Tnunder shower —cloudy
	25	60	81	.75	.75	S E.	do.	.05	Shower—clear.
	26	64	78	.76	.77	E.S.W.	do.	.14	Clear—rain.
	27	62	76	.63	.55	E.	do.	1.10	Cloudy—rain.
☉	28	52	73	.46	.46	W.	do.	.05	Cloudy—shower.
	29	55	65	.46	.50	W.	do.		Clear—do.
	30	48	69	.65	.65	W.	Brisk.		Clear—do.
	31	55	68	.70	.70	W.	do.		Cloudy—do.
	Mean	53.26	71.16	29 81	29.80			4.93	

	Thremometer.		Barometer.
Maximum height during the month.	83.	on 20th.	30.05 on 4th 6th & 8th.
Minimum " "	39.	4th.	29.46 28th & 29th.
Mean	62.21.		29.805

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

SEPTEMBER, 1839.

	County.	Town.	Observer.	Thermometer										Barometer	
											Register.				
				7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Lowest.	Mean.	Days omitted.	7, A. M.	2, P. M.
1	Philadelphia,														
2	Montgomery,														
3	Bucks,	Newtown,	L. H Parsons,	62.11	73.40	61.64	89.	40.	65.72	.	35.	50.60	.	30.02	30.01
4	Lehigh,														
5	Northampton,														
6	Monroe,	Stroudsburg,	A. M. Stokes,	54.93	69.26	57.13	86.	38.	60.44	$1\frac{2}{3}$	.....	.....	.	29.53	29.55
7	Pike,														
8	Wayne,														
9	Susquehanna,	Silver Lake,	E. Rose,	49.30	61.87	54.47	80.	33.	55.21	.	30.	46.23	.	28.10	28.10
10	Luzerne,														
11	Schuylkill,	Pottsville,	John Porter,	54.70	68.35	56.47	81.	35.	59.84	.	31.	49.93	.	29.22	29.21
12	Berks,	Reading,	C. F. Engleman,	58.	68.20	58.97	80.	39.	61.72	.	....	.....	.	29.81	29.79
13	Chester,														
14	Delaware,	Haverford,	Haverford School,												
15	Lancaster,	Lancaster,	Conservatory of Arts,	57.08	72.63	62.	86.	40.	63.90	1	38.	54.69	.	29.53	29.51
16	York,	York,	Calvin Mason,												
17	Lebanon,														
18	Dauphin,														
19	Northumberland,	Northumberland,	Andrew C. Huston,	57.83	68.23	59.53	81.	39.	61.87	.	31.	49.50	.	29.47	29.44
20	Columbia,														
21	Bradford,														
22	Tioga,														
23	Lycoming,														
24	Union,														
25	Mifflin,	Lewistown,	J. Culbertson, M. D.,	62.83	68.02	65.20	80.	45.	65.35	$2\frac{1}{3}$	....	.....	.	29.31	29.27
26	Juniata,	Mifflintown,	J. A. Kinkead,	59.87	69.39	62.74	81.	37.	64.	$\frac{2}{3}$	....	.....	.	29.53	29.49
27	Perry,														
28	Cumberland,	Carlisle,	Prof. W. H. Allen,												
29	Adams,	Gettysburg,	Prof. M. Jacobs,	55.02	68.91	59.28	82.	37.50	61.07	.	34.	50.36	.	29.44	29.42
30	Franklin,	Chambersburg,													
31	Huntingdon,														
32	Centre,	Bellefonte,	John Harris,	51.21	67.67	55.81	82.	28.	58.23	$3\frac{2}{3}$	25.	43.96	6	29.27	29.26
33	Potter,														
34	M'Kean,	Smithport,	Richard Chadwick,	50.10	64.77	52.03	82.	32.	55.63	.	30.	46.47	.	28.18	28.19
35	Clearfield,														
36	Cambria,														
37	Bedford,														
38	Somerset,														
39	Indiana,	Indiana,	Richard White,	59.23	64.00	62.50	78.	45.	61.91	.	.25	48.13	.	28.64	28.64
40	Jefferson,	Rose Cottage,	C. C. Gaskell,	50.20	66.58	54.00	80.	32.	56.93	5	....	....	.	28.92	28.99
41	Warren,														
42	Venango,														
43	Armstrong,														
44	Westmoreland,														
45	Fayette,														
46	Green,														
47	Washington,														
48	Allegheny,														
49	Beaver,														
50	Butler,	Butler,	Jacob Mechling,	53.97	65.82	59.45	81.50	36.	59.47	.	...	....	.	....	....
51	Mercer,														
52	Crawford,														
53	Erie,														

A very ingenious
on the railroad from
conveyed by the tra
speed of the steam-c
of speed, however ra
bly expediting the tr
consumption of stea
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exchanging the bags

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new improvements v
now perform six, se
short space of time.
000 spindles kept ir
enabled to spin 1,20
weekly produce of t
400,000,000 of mile

Meteoro

		Therm.		Ba	Thermometer								Register.			Barom			
Moon.	Days	Sun rise.	2 P.M.	Sun rise		2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Lowest.	Mean.	Days omitted.	7, A. M.	2, P. M.	9, P. M.	Maximum.
				Incl	83	68.02	65.20	80.	45.	65.35	2½	....	.....	.	29.31	29.27	29.30	29.6
	1	56	62	29	87	69.39	62.74	81.	37.	64.	⅔	....	.....	.	29.53	29.49	29.48	29.8
	2	53	76															
	3	50	64															
	4	39	54	30														
☽	5	42	69															
	6	46	68		92	68.91	59.28	82.	37.50	61.07	.	34.	50.36	.	29.44	29.42	29.43	29.7
	7	60	68															
	8	48	79															
	9	62	81	29														
	10	56	62	30	21	67.67	55.81	82.	28.	58.23	3⅔	25.	43.96	6	29.27	29.26	29.29	29.6
	11	40	70															
⊗	12	44	72	29														
	13	48	72		10	64.77	52.03	82.	32.	55.63	.	30.	46.47	.	28.18	28.19	28.17	28.5
	14	54	67															
	15	51	80															
	16	60	82															
	17	54	72															
	18	52	64															
	19	52	75		23	64.00	62.50	78.	45.	61.91	.	.25	48.13	.	28.64	28.64	28.63	29.0
☾	20	55	83		20	66.58	54.00	80.	32.	56.93	5	....	....	.	28.92	28.92	28.86	29.2
	21	60	76															
	22	63	76															
	23	52	57															
	24	53	67															
	25	60	81															
	26	64	78															
	27	62	76															
☹	28	52	73															
	29	55	65															
	30	48	69															
	31	55	68															
	Mean	53.26	71.16	29	97	65.82	59.45	81.50	36.	59.47	.	...	....	.	....	....	....	...

Maximum height during the
Minimum "
Mean

Barometer.						Weather.							Winds.																Hygrometer.					
2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
.01	30.03	30.29	29.74	30.02	.	17⅔	11⅓	⅔	....	....	....	..	5.253	.	.	2⅔	.	⅔	.	1⅓	.	.	.	13⅓	.	1	.	10	.	.	⅔	57.88	.	.....	....	.	891
.55	29.57	29.86	29.21	29.55	2	12	15	3	....	....	....	..	4.930	1	.	1⅓	.	1	.	⅔	.	2	.	5⅔	.	7⅓	.	8⅔	.	.	2⅓	....	.	.....	60.	14	839
.10	28.09	28.38	27.88	28.10	.	11	19	.	....	....	....	..	3.250	.	.	.	.	.	.	.	1	3⅓	.	13⅔	⅔	5⅓	.	6	.	.	.	....	.	.....	....	.	841
.21	29.23	29.89	28.94	29.22	.	16⅔	13⅔	.	....	....	....	..	6.058	⅓	.	.	.	⅓	.	2	.	½	.	4⅓	.	3⅔	.	6⅔	.	11⅔	⅓	....	.	.....	....	.	842
.79	29.80	30.10	29.50	29.80	.	15⅓	14⅔	.	6	....	....	2	3.221	2	.	1	.	.	.	3	.	.	.	4⅔	.	1⅓	.	17⅔	.	⅓	.	....	.	.....	....	.	824
.51	29.52	29.83	29.18	29.52	⅔	18	11⅓	⅔	6	....	....	1	3.198	1⅔	2	⅔	1	.	⅓	2⅔	.	1½	2⅔	4⅓	3	3	⅔	4⅔	1⅓	.	⅔	57.69	.	.....	63.65	.	827
.44	29.45	29.81	29.12	29.45	.	10	20	.	11	....	....	1	2.819	5	.	⅓	.	1⅓	.	⅔	⅔	8⅔	.	⅓	⅓	5⅓	.	3⅔	⅓	3⅓	.	....	.	.....	63.35	.	825
.27	29.30	29.62	29.03	29.29	1	8⅓	1⅔	20	6	....	....	1	....	.	.	6	.	.	.	⅔	.	.	.	19⅓	.	.	.	2	.	.	2	....	.	.....	....	.	858
.49	29.48	29.83	29.14	29.50	⅓	13⅓	14⅓	2⅓	....	...	...	..	....	.	.	⅓	.	.	.	4	.	.	.	7⅔	.	⅓	.	7⅓	.	10	½	....	.	.....	....	.	828
.42	29.43	29.73	29.13	29.44	.	18⅔	11⅓	.	5	....	....	1	2.394	1⅓	⅓	1⅓	⅓	.	.	.	⅔	1⅔	2⅓	5⅔	1⅓	3⅓	1	3⅓	1	6	.	53.59	.	.....	60.07	.	823
.26	29.29	29.60	28.93	29.27	3⅔	8⅔	17⅓	3⅔	8	....	....	..	4.502	1⅔	⅔	1⅓	.	⅔	⅓	1⅔	.	⅓	.	6⅓	1⅔	4⅔	⅓	6⅔	.	.	3⅔	....	.	.....	....	.	833
.19	28.17	28.55	27.88	28.18	.	7⅓	22⅔	.	13	....	....	..	2.850	⅓	.	.	.	3	.	1⅓	.	½	.	11⅔	.	6	⅓	4⅓	.	2⅔	.	66.01	13	.....	62.45	.	872
.64	28.63	29.00	28.30	28.64	.	15⅓	14⅓	⅓	....	....	....	..	5.319	.	.	⅓	.	1	.	1⅓	.	1⅓	.	2⅔	.	9	.	3	.	11⅓	.	....	.	.....	....		867
.92	28.86	29.20	28.39	28.89	5	6	16⅔	7⅓	....	...	....	..	5.251	.	.	.	.	⅓	.	.	.	⅔	.	6⅔	⅓	3	.	1	⅓	10	7⅔	54.52	7	....	62.87	7	847
....	....	....	....	....	.	.	.	.	....	....	....	..	....	.	.	.	.	.	.	.	.	1	.	8⅔	2	4⅓	.	.	.	.	14	....	.	....	....	.	829